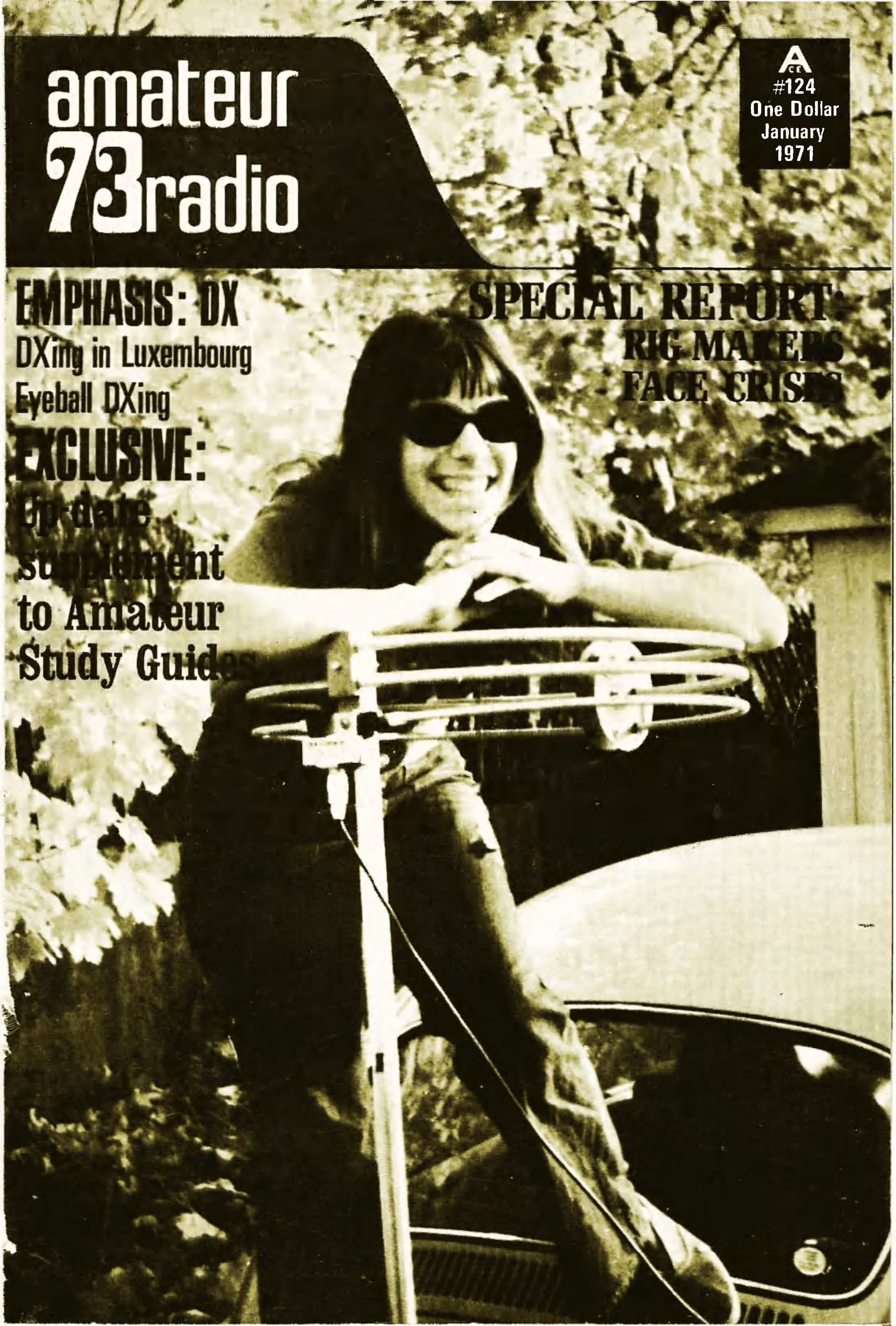
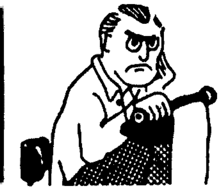

amateur
73 radio
#124
One Dollar
January
1971
EMPHASIS: DX
DXing in Luxembourg
Eyeball DXing
EXCLUSIVE:
Up-date
supplement
to Amateur
Study Guides
SPECIAL REPORT:
RIG MAKERS
FACE CRISES

Issue #124 **Amateur Radio 73** January, 1971



...de W2NSD/1

NEVER SAY DIE

The amateur radio market has been too small to really encourage the Japanese to tool up for massive competition until just recently. Now we are seeing more and more Japanese products appearing in the ads.

The first major import was the Yaesu sideband transceiver brought in by Spectronics. This was a well made unit and quite competitive with the American made equipment. Next came Henry's Tempo. Now Kenwood, one of the top names in hi-fi manufacturing, is now being imported by Henry Radio and should also become a very popular unit.

In the FM field the best known imports are the Inoue (imported by Varitronics), Telecomm, and Standard. Drake has just announced an imported transceiver designed specially for them.

Can the Japanese drive the U.S. manufacturers out of business? They've done a pretty good job of it in other areas such as transistor manufacturing, ball bearings, etc., so it is entirely possible that they might be able to take over a good portion of the U.S. ham market.

Should U.S. manufacturers go complaining to Washington and ask for protection as the makers of shoes and clothing have? Students of the complex import—export situation tell us

The result of this is a product turned out at a price that is extremely competitive almost everywhere in the world in just about any field they wish to tackle. The Japanese government helps by limiting or even prohibiting any competition from outside Japan, thus giving the companies a captive home market as a starter. This has been quite effective as anyone familiar with the camera, clothes, automobile, radio, television, and hi-fi markets will attest.

The car market is an interesting example of the ability of the Japanese to develop a strong export market. In 1955 Japan exported two cars. Just two. In 1960 this was up to 7000 cars exported to all countries. In 1965 they exported 101,716 Toyotas and Datsuns, of which 27,460 came to the U.S. In 1966 they sent 53,272 to the U.S. It only went up to 71,625 in 1967, a slow year, and up to 172,728 in 1968. In 1969 this was up to 168,070 passenger cars to the U.S!

A similar pattern occurred in the camera field, the transistor radio field, and others. Will this happen to the amateur radio business? The pattern certainly seems to be repeating itself.

Women's Lib II

My editorial comments on the Lib movement were not in

by Herter's the world over. The word "Point" on name was originally put in to indicate the value in beaver skins. Order out a pair today. . ."

The description goes on to explain that only the most expensive bull-hide leather is used and that only one hide in 200 is free enough from tick bites and flaws to go into these shoes.

The price of these fantastic shoes? Only $14.95. Who could pass up a bargain like that? Not me, for sure. I sent off for a pair and found them to be the most comfortable shoes I had had in years. I used them for hiking around New Hampshire, wore them on my safari in Africa, wore them around the world, and continued to wear them. They showed no signs of wearing out in any way.

Comfortable shoes have been difficult for me to find in the past so I had gotten in the practice of getting a second pair of any shoes that worked out well. I sent for a second pair of Herter's shoes and put them on the shelf. The first pair is now about five years old, has been worn almost every day, has taken me out on hunting trips, through mud, rain, snow, mountain climbing, hikes, and still fit comfortably, with no sign of wearing out or coming apart at the seams. The second pair is

still up on the shelf. I may not live long enough to get to them.

How is 220 Coming?

The prospects look bright for the Radio Today petition to open several hundred channels in the middle four MHz of the amateur 220 MHz band for a hobby-type amateur license which would be based upon a knowledge of rules and regulations only.

CB Magazine has come out in support of the petition (now known as RM-1633), adding a proposed change which would permit AM as well as the proposed FM operation. I can only assume that this is because the editor is not that familiar with FM, for the use of AM would go a long way towards duplicating the chaos now heard on 11 meters. The AM idea is supposed to make it simpler to use units which would convert CB gear to the new band. This can be done, of course, but the extra cost of having the converter provide the desired FM would be slight and the advantages manifold.

S-9 Magazine seems to like the idea also, but in their usually underhanded way they ascribed the petition to our greed which, if I read them rightly, has no known bounds. This is incorrect. Our greed knows bounds.

. . . W2NSD/1

73 Magazine is published monthly by 73 Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas, $7 per one year elsewhere. Two years $10 in U.S. and $12 overseas. Three years $14, and $16 overseas. Second class postage paid at Peterborough, N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. Entire contents copyright 1970 by 73 Inc., Peterborough, N.H. 03458. Phone: 603-924-3873. We could hassle you about subscribing, giving gift subscriptions, bugging possible advertisers and all that, but we won't. If you want to go through the next month with one of the blackest curses known to man on your head then all you have to do is ignore 73...do not subscribe...do not let Collins know that you thought they were out of the ham business because they have not advertised in 73 in over ten years. Go ahead and risk a curse so powerful that it could well have a serious effect even upon your family two generations later.

that the minute the U.S. sets up restrictions on imports we can expect a rash of ditto from other countries and that the result will be far worse than any possible benefits we might gather from restricting imports. The problem is Japan, of course, and it would not seem out of line to reciprocate the Japanese protective system which limits imports on many items.

Perhaps Drake has the best compromise, having their FM unit built in Japan and marketed here by their organization?

Why is it that the Japanese are able to compete so tellingly with U.S. companies? Most of the ICs are being made in the U.S. This means that the Japanese firm must by ICs from us, import virtually all of the raw materials, and then ship the finished product all the way back to us. In addition to the ocean or air freight on the product there is the markup of the importer, plus import taxes. In spite of all this expense, the imported products are still priced considerably below our own units of comparable quality . . . how is this possible?

The secret is, of course, the whole Japanese way of life. The productivity of the Japanese worker is far beyond that of most any other worker in the world. He joins a company for life and devotes his life to that company. He plans his own time so as to be sure that he will bring the best of health and energy to his job. He and his union work with management to effect the most efficient production of the product using the latest automation techniques (as opposed to many U.S. unions which do everything possible to prevent automation).

any way intended to cast aspersions on any gals, and particularly not our ex-editor Kayla, who did a man-sized job of tiding 73 over a very rough period.

Consumer Protection Department

One of the most delightful books in the 73 library is a catalog from Herter's in Waseca, Minnesota. This sporting goods mail order firm puts out a 650-page catalog that is highly entertaining. If you believe the catalog, just about everything they carry is the finest available anywhere at any price. Many of the items are made specially for Herter's and their described magnificence is overwhelming.

Strangely, though I have succumbed to many of their descriptions, I have yet to catch them exaggerating. For instance, take their Herter's Genuine Hudson Bay One Point Shoes, Men's. These are described as "the finest Oxford cut wilderness shoe procurable. Made of hand worked leather. Require no break-in. These world famous custom shoes are entirely hand cut and hand made. They are the French Canadian Moccasin in Sauvage shoe and not quite a newcomer. They have been proven the best for nearly two centuries. Do not mistake these famous shoes for so-called 'sport moccasins' production made of cheap leather. Such shoes stretch out of shape and come apart under rough use and will ruin your feet on rough terrain. Hudson Bay One Point Shoes are made for guides, forest rangers, trappers, game wardens, timber cruisers, scalers, and other professional outdoor people who want a low shoe for summer wear. Hudson Bay shoes are now solely distributed

The Cover: Jodi WA1JYV — our cover girl — can be found just about any time on 50.55 MHz usually mobile. Her VW bug has a Lafayette HA 460 crammed into its innards and sports a Saturn-6 halo. Jodi's halo doesn't show up well in bright sun. . .and this angel's technical statistics are classified.

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JAP INDUSTRY GETS TABLES TURNED!

CLAIMS U.S. UNFAIR!

For years the Japanese electronics industry has been the target of U.S. charges of "dumping." or selling items in the United States at prices that are below the market price in Japan. The effect of such tactics, say U.S. manufacturers, is to squeeze legitimate businesses here out of competition. But the Japanese electronics industry has been pooh-poohing the cries or ignoring them altogether.

But now the tide has changed a bit, according to a series of news items in Business Week, a McGraw-Hill publication. The Japanese manufacturers of integrated circuits are finding themselves squeezed out even in sales within Japan — and they're accusing American firms of the same "dumping" tactic. They say American IC and transistor manufacturers are dumping large quantities of semiconductors on the market at prices too low for the Japanese to compete.

Toshiba's president, Toshio Doko, said his firm has had to cut its prices sharply to compete with U.S. IC prices. Industry spokesmen here, however, label the "dumping" charge as ridiculous. It is merely a matter of production efficiency. In the U.S., because of increasing production and higher product re-

SALEM CIVIL DEFENSE GOES FM

The Salem RACES mobile units are equipped with Galaxy FM-210 transceivers which proved to give excellent coverage throughout the town. Civil Defense communications act as back up units for police and fire departments when needed as well as a separate communications network to be used in any local emergency. In the rear of the photo is the new Civil Defense antenna system which gives coverage for the town and to Rockingham County Civil Defense Sector headquarters. Salem is thought to be the first town in New Hampshire to go completely FM for Civil Defense Communications. Shown in front of the Salem police station, which also houses Salem civil defense headquarters, are members of the Salem civil defense RACES communications team with their mobile radio units. Left to right are: Melvin Marsh, CD Director, Merle Centner W8AOT, Samuel Burke WA1MOF, Warren Martel K1RCT, William Loeffler W1PFA, Communications Director, Donald Alexander W1UFK, Radio Officer, Anthony Coco K11LB, Radio Officer, and Kenneth Cheverie, W1QKG.

HAM HELPS SAVE A LIFE

New Orleans (AP) — A New Orleans ham radio operator's quick action enabled doctors to get snake-bite serum and save the life of a Colombian youth.

Eugene H. Treadaway said that he had talked by radio with a ham in Cucuta, Colombia, who had told him that the 5-year-old child had received the serum.

"Doctors said the serum saved the little boy's life," Mr. Treadaway quoted the Colombian ham as saying. "They say he is going to be okay and they won't have to amputate his leg."

Mr. Treadaway was on his short-wave radio when James H. Stiles, the Colombian ham, broke in on his frequency and asked for help in getting the serum.

Mr. Treadaway made contact with the United States Public Health Service Hospital, where an official called the hospital's outpatient clinic in Miami and had the serum flown to Colombia.

FCC SUSPENDS

liability, individual IC prices have been dropping.

According to one of the Business Week news items, Japanese consumers have been "incensed" to learn that a TV set made in Japan to sell (in Japan) for $500, can be purchased in the United States for about $200. While this may serve as reasonable agitation for the Japanese consumer, it has proved a real thorn in the side of U.S. manufacturers, who must either make their own sets to compete with the imports, or give up the manufacturing of them altogether and join the importing game themselves.

It is not surprising that American electronics manufacturers are amused now that the shoe is on the other foot.

HAM'S CALL RESCUES STRANDED FAMILY

Heber City, Utah (AP) — A North Carolina ham radio operator recently relayed distress signals from northeastern Utah's high mountain country and helped in the rescue of a Salt Lake City couple and their two children.

The authorities said that Mr. and Mrs. Phillip Gordon and their children were stranded on a mountain road when their pickup camper got stuck in mud.

Distress signals from their short-wave radio were unable to reach nearby Heber City or Salt Lake City because of the mountains. So Mr. Gordon aimed the signals eastward where they were picked up in North Carolina.

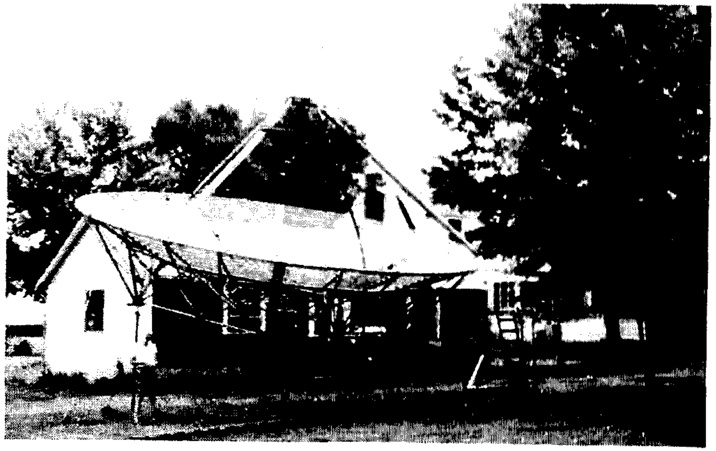
The North Carolina ham, who was not identified, radioed an operator in American Fork who then relayed the message to the Wasatch County Sheriff, Floyd Witt. The family was rescued.

FAMED EME SITE TO BE DISMANTLED

by WA3AJR

Bill Smith (W3GKP) was the first ham radio operator to make EME (moonbounce) on 2304 MHz, and he didn't do it with an ordinary dipole. As the photo shows, it takes a real antenna. The approximate size of the big dish can be estimated by comparing it with Bill himself, who is standing at the lower right. In this picture, he is actually closer to the camera than the dish itself.

According to Smitty, he will be leaving the area soon, and the historic site will be no more. The dish? It goes with Smitty, of course!



MOON REPEATER TO PERMIT INTERCONTINENTAL UHF QSOs

by N. K. Marshall W6OlO/2

The design, development, and test of an operational prototype UHF amateur repeater unit is now in progress and final construction of a flight model is imminent. When completed, NASTAR hopes to have NASA carry the Moonray repeater to the moon via one of the remaining Apollo missions. One of our astronauts will emplace and activate Moonray I. Target objective is to have a continuously operational repeater for a period of one year or longer.

Moonray's primary purpose is to serve as a free-access UHF repeater for worldwide line-of-sight amateur communication and experimentation within the 450 MHz band. A secondary function will be its capability to serve as an emergency backup voice communication link for our astronauts in the event of an unlikely (but possible) breakdown or failure of their regular communications system. Moonray can also be used as a landing-site relocation beacon for homing-in on the site at some later date. If the laser experiment is successful, location accuracy will be better than 2 ft.

Moonray I will contain a highly sensitive low-noise receiver, a signal processor, an identifier, a timer-cycler-sequencer, six to eight channels of telemetry, and a laser receiver with optics. Power will be supplied by an isotope-fueled thermoelectric generator having a half-life of 87 years. Thermal controls, antenna, pointing system and all auxiliary devices will be self-contained. The final package will be a metal cylinder about the size of an oatmeal box. Three retractable legs will be used for support and leveling. The up-link frequency will be 439.9 MHz and the down-link 430.1 MHz. A 10 kHz passband on both links will accept all modes of modulation and/or transmission.

Moonray's call sign will be the identifier SS in Morse code (. . . . . .) transmitted every 10 minutes along with a telemetry sequence. Repeater operation will be on a continuous-duty basis with only one-minute interruptions each 10 minutes.

Amateur ground stations should have high-gain antennas capable of tracking the moon; low-noise 430.1 MHz crystal-controlled converters, and stable, tunable i-f's. Detailed info on Moonray is available from NASTAR, Box T, Syosset, LI NY 11791.

LICENSE OF WB4GTG

Obscenity, Out-of-Band, and Other Violations Cited.

The FCC moved to suspend the Advanced class lisence of Brad McGann (WB4GTG) after noting a number of alleged violations. According to a recent order from the Commission, the licensee allegedly committed the following infractions of Amateur Rules and Regulations:

Transmitting a false call sign; operating on frequencies that are reserved for Extra class operators; operating his equipment completely out of the amateur band; operating his phone station in portions of the 80-meter band that are reserved for CW transmissions only; transmitting "obscene, indecdent, or profane words, language, or meaning" in violation of Section 97.125 of the amateur rules; willfully and repeatedly interfering with other ham radio operators; and broadcasting of communications that were intended for reception by the general public.

In a quotable understatement, the FCC report said McGann's alleged actions were not serving the public "interest, convenience, and necessity." At the conclusion of the federal report, an order of suspension appeared as follows:

"It is ordered, under authority contained in Section 303(m)(1) (A), (D), and (E) of the Communications Act of 1934, as amended, and Section 0.332 of the Commission's rules, that the Advanced class amateur operator license of Bradford Y. McGann is suspended for the remainder of the license term. . ." (till September 1973).

PICTORIAL PAGE

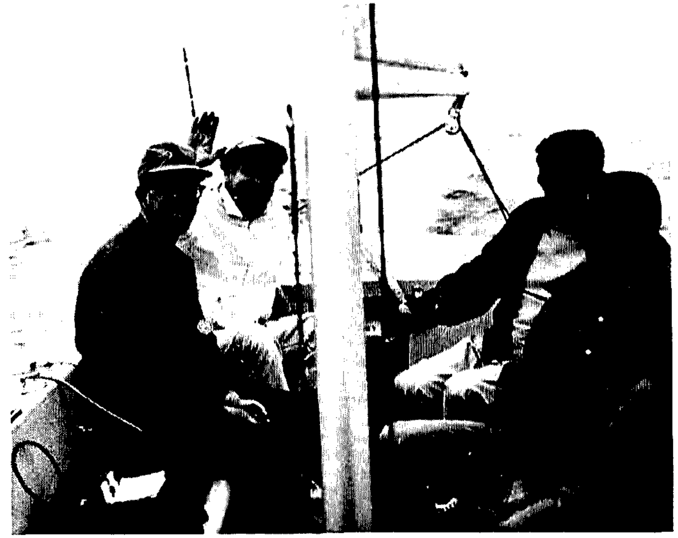
TO THE HAMFEST BY SAIL !

by Jesse G. Ball,

In announcing the annual summer picnic and hamfest the WCARS monthly newsletter said: "Jump in your car, cycle, truck, or plane and come to our picnic and meet the whole gang."

Some of us decided to be different and arrive via sailboat. Jim (WA6MYJ), Paul (WA6VRT), Gil (WA/ULA, Joe (a nonham), and I climbed aboard the Columbia 21 and headed south out of the California coastal village of Marina Del Rey.

On board was Jim's SW 240 and Gil's Comm II. Contacts were made on 2 and 40 meters as we "broad-reached" down and "close-hauled" back. Power for the rigs was a 1.25 kW ac generator. Crew fuel was chiefly beer.



Hamfest mobile: (L to R) Joe, Jesse (W-6BFO), Paul (WA6-VRT), and Gil (WA-6ULA) thought up a novel way to get to a California hamfest. Holding the call-letter flag is Jim (WA6-MYJ).

QSL MANAGER OF THE MONTH

The very attractive Mary Ann Crider, Scott's QSL Manager of the Month, has taken on QSL manager duties for some thirteen stations over the last year and a half. These stations include CTIOF, CTILN, CT2AA, CT2AP, CR6GA, and CEØ AE -op. Father Dave, along with several others now QRT.

Mary Ann spent the first eight months of her activity as a Novice. During this time she acquired a WAC and a WAS along with 86 countries. She has to this date added 207 countries to this total and now has 285 confirmed. Her awards have also grown noticeably to include WNPX, WAC, WAS, DXCC,

HELP FOR THE NEEDY

Mohawk Airlines Stewardess and Uncle Dave delivering drugs for cancer victim. First shipment lost, duplicate shipment had to be made. The second shipment arrived in less than sixteen hours.

SENTRY GETS BID FOR WORLDWIDE EXHIBIT

Sentry Manufacturing Co., a Chickasha, Oklahoma electronics has been selected by the U. S. Department of Commerce to represent the latest state of electronic technology at "Electronica CA 1970", a worldwide industry fair held in Europe every two years. The only firm so honored from Oklahoma, it is one of two in the Southwest to be invited to exhibit its products at the show held in Munich, Germany. The event is the most widely attended electronics fair in Europe and draws worldwide attendance to see the latest product state-of-the-art advances in the industry.

Sentry will display its line of precision crystals, precision temperature-compensated oscil- their trouble racked moon trip.

Don Abel, president, and Peter Warren, sales manager, will attend the show. Abel revealed for the first time publicly that Sentry will also display a new series of quartz crystals developed as timing elements in wrist watches. "It will be the most accurate timing system for wrist watches known," he said.

60% EXPANSION FOR HEP LINE

Motorola has introduced 109 new semiconductors through HEP distributors to the hobby/service and radio amateur mar-

WAZ, WPW (worked Portugal world) to mention just a few. She is a member of YL International SSBers and YLRL.

Mary Ann and her husband Charles W3GE, an amateur of 32 years, have three children and two grandchildren. They have visited several countries, including Jordan, where she operated JYI from King Hussein's station.

As QSL Manager of the Month, Mary Ann was awarded the "golden microphone" trophy. Nominations for QSL Manager of the Month should be sent to Scott's QSL Service, 1510 Lynnview, Houston TX 77055. They should include a short summary of why the manager deserved to receive the award.

NEW VHF XSTR!

Lawndale, Calif. TRW Semiconductors announces the industry's most powerful 150 MHz communications transistor. The new unit, type PT6729, delivers 120W rf power output with a 6 dB gain from a 28V source. Package is a 4-lead diamond configuration. For technical details contact TRW Semiconductor Division, Communications Transistor Plant, 14520 Aviation Blvd., Lawndale CA 90260.

Operation Goodwill, the Christmas service sponsored jointly by the Times-Union and "Uncle" Dave Marks of the now-defunct Fort Orange Radio, is usually dormant during the summer months.

But the disastrous earthquake in Peru has activated a large-scale response from the Albany area through radio contacts established by "Uncle Dave" and Operation Goodwill. With the cooperation of the Albany Rotary Club and scores of other volunteers who have been donating and shipping money and supplies to the earthquake victims, thousands of dollars worth of aid has been transmitted.

WHAT'S HAPPENING ON 220 MHz?

by K6MVH

There's a fellow out in California who's publishing a monthly newsletter describing the action in that state on 220 MHz. He says that the active groups in California would like to encourage other amateur 220 operators to speak up about what they're doing in their own areas, so that a rationale can be developed for the exchange of ideas and information.

The fellow's name is Don Farwell (WA6GYD), and his newsletter is currently being distributed without charge to other interested ops. If his circulation improves as a result of this little blurb, you can bet he'll start charging a subscription fee — it costs money to mail things these days. So why not get on his mailing list now and get the advantages of learning what circuits the 220 boys are using. In addition to short technical articles, Don's newsletter usually carries some classified ads and just enough of the hometown gossip to keep his sheet interesting.

A first aid shipment from Albany was sent from Albany Airport and word was received it had arrived in Lima, Peru, just two days later. The Lima Rotary Club is responsible for distribution of the funds and supplies sent by local Rotarians.

The most important needs now are for building shelters, tents, blankets, medicine and money, according to the relief workers. More than sixty Albany Rotary members gave funds following a Thursday appeal by Uncle Dave.

Quoting a report from Albany's *Times-Union*, "It is encouraging to know that Operation Goodwill and its thousands of supporters can be counted on at a time of tragedy."

EMPTY SHACK

Death has claimed Stanley Roberts (G6QS). Roberts was the first British amateur operator to work every one of the United States. According to his widow, the G6QS station was active every day. "Hamming was his life," she said. Stanley's fellow amateurs the world over are aggrieved by his passing.

Ninth Wheaton Swap 'n' Shop

The Wheaton Community Radio Amateurs (WCRA) will hold their ninth annual Mid-Winter Swap and Shop on Sunday, February 21, 1971 at the DuPage County Fair Grounds. Wheaton, Illinois. Hours — 8:00 a.m. to 5:00 p.m. $1.50 donation at the door. Send SASE for advanced tickets to Box QSL, Wheaton, Illinois. Refreshments and unlimited parking. Bring your own tables. Free coffee and donuts 9:00 to 9:30 a.m. Hams, CB'ers, electronic hobbyists, friends, and commercial exhibitors are cordially invited. Contact John Stockberger (W9THI).

lators and its "Covistor," the tradename coined for its highly efficient positive temperature coefficient resistors that are used in computers.

The relatively young Oklahoma electronics firm is engineering-minded and recently gained national attention when it supplied critically needed crystals under emergency conditions to aid the last minute air-ground communications with the Apollo 12 astronauts to assure a safe splashdown after

SSTV WORLDWIDE

"CQ Elettronica" Magazine proposes and sponsors the 1st Worldwide SSTV Contest to be held on Feb. 7 (0700—1400 GMT) and Feb. 13 (1600—2300 GMT). Suggested SSTV frequencies are 3.740, 7.050, 14.230, 21.100, 28.100 MHz. A pix exchange is necessary, though the message number may be given by voice.

A two-way contact with a station receives one point (total points will be the number of individual stations contacted). No extra points will be allowed for contacting the same station on different bands. A multiplier of 5 points is given for each continent worked. Score logs must contain: date, time (GMT), band, call sign, message number sent and received points.

To encourage those who have no SSTV transmitting gear, a special prize will be awarded for the best collection of photographs of received SSTV pictures. Prizes: 1st prize — One silver thaler of Maria Theresa. 2nd prize — A free 12 month's subscription to "CE Elettronica" magazine.

All logs must be received by 28th February 1971. They should be sent to Prof. Franco Fanti (I1LCF), Via Dallolio, 19; 40139 Bologna, Italy.

kets, accounting for a 60% increase in the electronic firm's number of HEP semiconductors.

"The new devices include integrated circuits, rf power transistors, FETs, Triacs, SCRs, Darlington amplifiers, and high-current rectifiers" says Art Baldensperger, Motorola HEP sales manager. "Several replacements for Japanese and other foreign transistors have also been added to the HEP line. These and other devices are all included in the latest edition of Motorola's HEP Cross Reference Guide and Catalog HMA07."

The HMA07 catalog lists HEP replacements for over 27,000 different semiconductor device type numbers, available through authorized HEP suppliers.

HEP is Motorola's sales program for making semiconductor devices readily available to experimeters and hams through a nationwide network of authorized suppliers.

40m PHONE CITATIONS

Somewhere an FCC monitoring station employee apparently noticed in the fine print (Part 97, Appx 2, Resolution 10) that foreign broadcast stations are permitted to use the 7100-7300 kHz part of the 40m amateur band as long as they do not direct their transmissions into region II (North and South America). He surmised therefrom that U.S. amateurs should in turn not communicate on 40m with the other two regions.

A number of U.S. amateurs received advisory notices after making contacts with European amateurs cross-band between the U.S. phone band and the European phone band (below 7100 kHz). Naturally, a scream went up that was heard clearly in the hallowed halls of the FCC Amateur Division in Washington and things got straightened out quickly. After a quick huddle, the Fed decided that contacts with European phone stations are still permitted on 40m phone.

DX NEWS

BOUVET ACTIVE!

A small group of Norwegians have set up on Bouvet Island on a scientific expedition and are on the air using the call 3Y3CC. They have been active on CW around 14.030—14.040 twice daily 0900—1200 and 2100—2400Z. SSB operation is expected shortly. QSLs go to LA3CC. The group is expected to be active on Bouvet until February 17th.

YEMEN STATIONS

LA8YB/4W1, operator Finn, has been contacted by a few U.S. stations, but has been concentrating more on European contacts so far. Finn is expected to be in Yemen for a year, so no reason to panic. MP4BHH has been lending him a hand with the pileups. Finn has been on SSB mostly, even getting down on 3800 at 3200Z, but is heard more on 14.195—14.230 and even 14.332 from 1430—2000Z. 4W1AK has also been reported active on CW (14.027 at 0630Z).

TOKELAUS

VE7HE and VE8RA made a quick trip to this rare spot in late November operating as ZM7AG and ZM7AH. QSLs go to VE7BWG. This was a nice Thanksgiving present for the DX hunting contingent. ZM7 activity is indeed rare so you have to watch for quickies like this if you are going to get your country totals up into the 300s.

SUDAN

ST2SA, Sid, now has an HW-100 SSB rig and has been getting on almost daily to work away at the pileups, 14.200—.250, usually around

COCOS-KEELING

If you still need VK9YR you should look for Chris around 14.250 at 1000—1600Z and QSL to VK6RU.

MACQUARIE ISLAND

Watch for the two ops on this rremote spot using the call VK0 LD, reported on around 1000—1600Z on 14.162. QSL to ZL2AFZ.

NEED NAURU?

Derrik C21GB will be there until the end of May. He operates mostly on Tuesdays and Thursdays around 14.160 about 0900Z. You'll have to call him on CW and get him to tune up for you on sideband. Another station is due to be active from Nauru before long, so don't worry too much if you have a hard time getting C21GB.

WAVE/WACAN RULES

Toronto's Nortown ARC (VE3NAR) is the sponsor of two long established and internationally famous AWARDS — WAVE (Worked All VE) and WACAN (Worked All Canada). Rules are listed below.

Rules for WAVE Award. Produce QSL cards to verify QSO with 2 different stations on 2 different bands in each of the following 9 provinces: Prince Edward Island (VE1), Nova Scotia (VE1), New Brunswick (VE1), Quebec (VE2), Ontario (VE3), Manitoba (VE4), Saskatchewan (VE5), Alberta (VE6), British Columbia (VE7); cards from Yukon and or Northwest Territories (VE8) may be substituted for British Columbia (VE7). All contacts must be made from an area within a radius of 150 miles of one point and after January 1, 1939. Submit the 18 QSL cards with $1 or 10 IRCs. Cards will be returned.

6th ARKANSAS QSO PARTY

The North Arkansas Amateur Society of Harrison announces its sixth Arkansas QSO Party and invites all amateurs to participate.

RULES:
(1) The time will be the 30-hour period from 2200 GMT January 23 to 0400 GMT January 25.
(2) Arkansas stations score 1 point per contact and multiply by the number of states, Canadian provinces and foreign countries worked during the contest period.
(3) Outside stations score 5 points for each Arkansas station worked and multiply the total by the number of counties in Arkansas worked during the period.
(4) Stations may be worked once on each band and each mode.
(5) A certificate will be awarded to the highest-scoring station in each state, Canadian Province and foreign country with 100 or more points.
(6) General Call: "CQ ARK". Arkansas CW stations should identify themselves by signing "de (call) ARK K." Phone stations should say "Arkansas Calling."
(7) Suggested frequencies (plus or minus 5) will be; CW 3560, 7060, 14,060, 21,060, 28,060; SSB: 3960, 7260, 14,300, 21,360, 28,560; Novice: 3735, 7175, 21,110.
(8) Arkansas stations send QSO number, RS(T) and county. All other send QSO number, RS(T) and state, province or country.
(9) Logs and scores must be postmarked no later than February 9 and sent to the North Arkansas Amateur Radio Society, c/o J. K. Fancher, Jr., W5WEE, 407 Skyline Terrace, Harrison AR 72601.

On and on, like Tennyson's brook, goes the Big Brag. The editorial policy of QST can be depended upon to voice consistently this parting over and over again, that since the "League's in its Heaven, all's right with the world." It's all very confusing.

In the November issue, the lead paragraph states "...organized amateur radio ...meaning our ARRL, and all its affiliated clubs, and all the other amateur radio societies in the world, and the International Amateur Radio Union." Is it not remarkable how deftly the editorialist has expunged from existence the hundreds of thousands who are not members of the groups cited? With a couple of masterly executed strokes of his pen, together with a few appropriate hooplas and an abracadabra or two, he has rendered them all *hors de combat* and *persona non grata*! By viewing them as nonmembers of *these* organizations, he concludes perforce, that they are consequently beyond the pale of "organized amateur radio." What would happen, one wonders, if in similar fashion the major political parties were to be silly enough to dismiss as unimportant and not deserving of inclusion in their deliberative strategy all voters who were "unorganized" because they were not regularly registered in one of the preferred parties? They would fail to win elections, and they would atrophy due to their short-sightedness.

Don't misunderstand me, please. I do not mean to imply that the U.S. delegation to the forthcoming international conference will misrepresent the interests of those hams who are not members of the League, the clubs, etc.; probably the opposite is true. In fact, I cannot conceive of any delegation from any other country represented, which will be more firmly committed to the principles which will favor amateur radio. I am merely referring to the constant failure to acknowledge publicly that there are matter, how about DJ or JA? If and when you have contacted one or some of these, I'm sure you were not particuarly concerned with the composition of the government, the political persuasion or the past history of these countries. In fact, I cannot think of any amateur who would spurn a contact with a BY if he happened to hear one, despite any political considerations.

The point I'm trying to raise for a certain gent by the name of Max Sherr, who did not sign his call to a rather incoherent and fulminating letter in our November issue, is that if an amateur were to insist upon all his contacts conforming to a political accepptability test before consenting to work them, he might find himself in a position of isolation.

To regard his position of unwavering opposition to King Hussein, the fact is, as pointed out (not only here by Wayne Green, but by the Society of Friends (Quakers) who are certainly no apologists for political repression), Hussein is one of the very few in the Middle East who are seriously attempting to steer a moderate course in the baffling crisis in that unhappy area of the world. I strongly suspect, and I put it to you, that Mr. Sherr is not a bit interested in the facts, but prefers to regard *all* Arabs as enemies, for his letter is filled with half-truth, innuendo, and outright falsehood.

Apart from his departure from factual accuracy, Mr. Sherr gives the distinct impression that he feels that we should avoid all contact with those with whom we disagree, or whose politics are reprehensible to us. He leaves no doubt that he suffers with a pronounced allergy...Arabs. In this connection it is interesting to note that JY1 has been actively sought out and worked by scores of 4X4s, who would surely have more legitimate reasons for avoiding him than does Mr. Sherr! If Israeli hams can find

1430, but as late as 2300 or so at times. Sid likes lists and has been helped at times by 7Z3AB. QSL to Box 253, Medani, Sudan. Sid appreciates help, so try and give him a hand when you hear the big boys starting to crush him in their unmerciful way.

TRAGEDY IN TONGA

VR5DK is now being operated by the widow of WA6DKW, who suffered a heart attack while on a DXpedition there in early November. Darlene has gamely taken over after OM Gene passed away. Gene Souligny and his wife (WN6FSC) had planned on operating from Tonga for about three weeks. QSL to the W6 bureau.

MALI

What may possibly be the first legitimate DX operation from Mali took place in early November when DJ6QT and DJ1QP went on with the call TZ2AB. They contacted Lloyd Colvin W6KG, who spent two fruitless months in 1967 trying to arrange for a license, that theirs was the very first license ever issued by the Mali government. This raises some questions perhaps better not asked of one or two previous "expeditions" to Mali. The team operated only a short time from Mali and then went on to operate as XT2AB from Upper Volta and TYØACD in Dahomey. Good show.

THE GAMBIA

Look for ZD3D around 21.410 at 1800—2000 Tuesdays and 14.225 around 2200Z. Sometimes contest-style contacts, sometimes a list. QSL to VE2DCY. Good luck.

Rules for WACAN Award (for holders of WAVE Award). Produce QSL cards to verity QSO with 2 different stations on 2 different bands in each of the following 3 sections. Labrador and or Newfoundland (VO), British Columbia (VE7), Yukon and or Northwest Territories (VE8). Submit the 6 QSL cards, WAVE award No. and $1 or 10 IRCs. Cards will be returned.

CASCADES CLUB REVIEWS CRASH DRILL

A simulated airplane crash and emergency alert review was the primary topic of discussion at the latest monthly meeting of the Cascades Amateur Radio Society. CARS members were stationed at Parkside High School, the site of the simulated crash, and Foote, Mercy and Osteopathic Hospitals. Utilizing mobile and portable ham radio equipment, they provided the only two-way communication between the various hospitals and the emergency site.

Lt. Col. O. V. Best, former Jackson County civil defense director in charge of the drill, said the communications provided by CARS members was much improved over former drills. This was the first civil defense drill in which CARS members participated.

Two CARS members were present at each location, and used regular AM and SSB equipment on the 10m band.

Radio communications for the alert was accomplished under adverse conditions. A worldwide ham radio contest involving literally thousands of amateur radio operators was being held on the same simulated-emergency frequency. This fact illustrated to CARS members that they could operate under less-than-ideal emergency conditions and maintain effective two-way communications.

FRESNO DXERS MEET

The annual Fresno DX convention will be held on January 30 and 31. For registration information, write K6RQ, Frank Glass, 14910 Bascom, Los Gatos, CA 95030.

W8 Swappers!

Blossomland Amateur Radio Association's 4th annual auction and Swap-Shop will be held at Shadowland Ballroom, St. Joseph-Benton Harbor, Mich, Sunday, March 14th 9:00 a.m. to 4:00 p.m. Hot Food. Prefer to do your own selling? Rent one of our swap tables. If that fails, let our skilled auctioneer put your gear on the block. Direct inquiries to BARA, Box 175, St. Joseph MI 49085.

WAØSKP SUSPENDED

The FCC has released an order suspending the amateur license of Thomas Berryhill. In a full-page report disclosed to 73 News, the FCC's legal advisory chief, J. Russel Smith, said that Berryhill (WAØSKP) appeared to have violated a number of FCC rules. The order alleged that Berryhill operated amateur radio station WAØSKP without identifying it at the beginning and end of each single transmission or exchange of transmissions and at proper intervals, and that he operated on the frequencies 7320, 7325, 7360, 7415 and 7450 kHz, all of which are out of the band. Accordingly, the report stated: "It is ordered, under the authority contained in Section 303(m)(1)(A) of the Communications Act of 1934.

indeed great numbers of hams whose presence on the face of this planet is systematically ignored in the writings of this worthy gentleman, as though they simply did not exist.

If the League, as it is often wont to proclaim, would like to grow in membership, and assuming that such growth would involve those who are presently licensed, rather than those yet to come, this neglectful oversight is hardly likely to endear it (ARRL) and impel them with any burning desire to join us.

The last part of the editorial reads, "...your membership in the League helps immeasurably in this defense..." (meaning amateur privileges; my definition) "without it, and the support of tens of thousands of your fellow members, the outcome would most certainly be less favorable to our cause." If this is true, then how much stronger would this cause be served if the League would make itself aware that there is a body of amateurs actually functioning — living and breathing, and yes, operating their stations — who are not even considered important enough to be mentioned within the context of an editorial relating directly to their privilege also.

One constantly hears outraged and indignant accusations of attempting to undermine the ARRL. One is constantly suspected of tearing down the foundations of the League in order to help a certain nameless editor sell more copies of a specific unmentionable magazine. But not one of these zealous guardians, the protectors of the League against the unprincipled attack of these dastardly and treasonous villains, ever stands up in defense of the huge body within the amateur community which exists outside the League. It is, as I said, very confusing.

* * *

When did you last work on EA? A CO or an SV? For that the ability to distinguish between ham radio and politics, and can make a clear distinction between the two, by what stretch of the imagination, and by what brand of Talmudic casuistry does Mr. Sherr justify his rigidity of attitude and his overtly expressed bigotry?

Another significant part of his ill-considered diatribe, however, is his condemnation of editorials which go beyond the ordinary scope of ham radio, per se. This is strange indeed, since it is precisely this which he does when he denigrates the amateur operator, JY1, simply because he happens also to be the king of the Hashemite Kingdom of Jordan! How come he suddenly goes in another direction where this particular ham radio station is concerned, and that's okay...but when Wayne Green does it, that's wrong?

So far as his refusal to divulge his call because he fears that assassins or terrorists may seek reprisals against him, this is merely an indication of his degree of wild-eyed prejudice. His fears of reprisal are pretty close to that condition known in abnormal psychology as paranoia.

It is a mighty good thing for everybody that most of the leaders of both sides in this terrible Mideast crisis, are not similarly motivated by rabid hatred, and are seeking some accommodation. Of course, there is a lot of power play diplomacy and pressure politics going on...that is nothing new to international affairs. But if the leaders in that area were as rigid and unyielding in their approach, war would be inevitable. Any refusal to put aside prejudice and an insistence on bludgeoning the opposition into submission can have but one result: a holocaust which will solve nothing.

I fear that Mr. Sherr has failed to do his homework. His "facts" leave me completely unconvinced of anything except his blind, unreasoning bigotry.

Mr Virgo Himself

Editorial by Ken Sessions

Wayne Green for President?

At a radio club meeting in Long Island, I had the chance to meet with Harry Dannals, Hudson Division director of the ARRL, and to discuss with him some of the problems and good points of the League. The discussion set me to thinking about the needs of the League and its responsibilities to members and amateurs in general. The upshot was an idea that I think is not only sensational, but a panacea for the ills of our ilk.

First, ask, "Where does the League fall short?" I won't deign to go into that question, because nearly all amateurs have different views. But following up with, "What can be done to improve amateur radio as well as the League's representation of amateur radio?" could lead to some startling insight and prospective answers.

For example, Wayne Green contends that amateur radio should be represented in Washington by a lobby. Few hams would dispute that. Wayne thinks a public relations firm should be commissioned to bring a new awareness of ham radio to the general public. This, too, makes good sense. Wayne feels that the League's executive directors should be made more responsive to the needs and demands of the members — that the League should be the voice

The FM Scene

What is 146.96? When you order crystals for a local FM channel or repeater, then suddenly realize that you're transmitting a few kilohertz away from the standard, don't blame the crystal manufacturer. And don't write nasty letters to the manufacturer of the transceiver you're using. The problem? More often than not, it's a case of "double standards." What is accepted as being 146.94 in Chicago, for example, is several kHz above what the New Englanders call .94. The same has been proving true for repeaters and channels all over the country, much to the consternation of crystal and transceiver manufacturers. Before you complain to anyone about a crystal or oscillator being off frequency, do something positive about checking your own local channels. By "something positive," I mean that you should check frequencies with not less than two items of professional test equipment.

Standards for Tones. Current standards for amateur repeater use revolve around the concept of 150 Hz spacing between tone "channels." The 150 Hz spacing allows a safe "guard" band between tone frequencies to insure that users of one repeater do not trigger the facilities of another when units drift or frequencies are off a bit. The con-

Caveat Emptor?

CLASSIFIED, ETC.

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business venture. No display ads or agency discount. Include your check with order. Deadline for ads is the 1st of the month two months prior to publication. For exmaple: January 1st is the deadline for the March issue which will be mailed on the 10th of February. Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads. We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue. For $1 extra we can maintain a reply box for you. We cannot check into each advertiser, so *Caveat Emptor. . .*

OSCILLOSCOPE HEWLETT-PACKARD 170B professional instrument DC-20MHZ dual channel probes and accessories complete and brand new $950. Bobby L. Duke K5DZM, 13526 Pyramid Dr., Dallas TX 75234.

100 USED TV CAMERAS excellent for ATV. Running condition $125 each; "as is" condition $75 each. Shipped in 10 days. Don Heringhaus WA8ZRZ, Rural Route 1 Box 77, Ottawa OH 45875.

QUICK-COAX 2 METER COAXIAL ANTENNA KIT. All parts and step by step instructions included $6.73. Instructions 37¢. A. C. McIntosh, Jr., P.O. Box 572, Mundelein IL 60060.

450 MHZ FM BASE, RCA 20 watts, C.O.R., A-F Hybrid for repeat, Disc. Meter, Multi-position Meter, Table Top Units, $125. K2LIU, R.D. 3, Freehold NJ 07728.

SELL: Swan 350C with AC Supply, asking $350; Swan DC Module $40; Mars Oscillator $40; Hy Gain 14AVQ vertical Antenna $35; Budd Code Practice Oscillator $10; John Fearon, 3384 Peachtree Rd., N.E., Suite 705, Atlanta GA 30326. W4WKP.

NEED FOLLOWING ISSUES OF 73 to complete my collection. March 1963 Dec. 1963, June 1966 July 1966. Lance Lee, 301-7th Ave. E., West Fargo, ND 58078.

DERRICK ELECTRONICS will not be undersold on new Swan, Drake, Galaxy, Hy-Gain or Mosley equipment. Check around, then write, Box 457, Broken Arrow OK 74012.

MODEL 19 TELETYPE, good operating condition, for sale or trade. (202)-234-4678, P. S. Richter K1SDX/3, 2727 29th St. N.W., Washington DC 20008.

SELL: HQ215 for $295; Sencore FE16 with HV probe, new for $75. M. C. Smith, 614 Bradbury Rd., Monrovia CA 91016.

WANTED: Phono record or tape recording of Catholic High Mass sung in Latin, or information where to buy. Write: WA7NSO, 501 So. Ash St., Centralia, WA 98531.

MSI-DTL INTEGRATED CIRCUITS: Guaranteed new - gates 56¢, F6F 72¢, MSI $2, dual lamp drivers $1.60 — other inexpensive parts. Mitch-Lan Electronics Co., Dept. 7371, P.O. Box 4822, Panorama City CA 91402.

MOTOROLA 80D: 12 volt transceiver, crystal'd on 52.525 Mhz, easy to multi-freq; $60 or trade for Motorola 450 Mhz base. Ed Pores, WA2ZBV, 16 Dorchester Drive, Manhasset NY 11030.

"1971 TESTS-ANSWERS" for FCC First and Second Class License, -plus- "self-Study Ability Test." Proven! $9.95. Satisfaction guaranteed. Command, Box 26348-S, San Francisco CA 94126.

VHF-UHF COMMUNICATIONS RECEIVER, A.M., covers from 225 to 400 Mc. 750 discrete frequencies selected with external switch box. Design similar to ARC-27, but much smaller. Original government acquisition cost $18,350. Good for conversion or parts. Salvage value much more than my price of $25. Send for detailed information. Money back guarantee. Richard W. Solomon, 19 Pierce Road, Watertown MA 02172.

HEATH SB 301, SB 401, $275. each or $525 both. Three 10' sections Rohn No. 25, $15 each. Ken, WB6BNU, 19400 Sorenson No. 131, Cupertino CA 95014.

UTAH AREA the size of Delaware and Rhode Island with 80 families served by independent telephone company needs career maintainer for entire system. Broad ham background useful. W7NVY or 702 359 0586.

THE 20th ANNIVERSARY DAYTON HAMVENTION will be held on April 24, 1971 at Wampler's Dayton Harra Arena. Technical sessions, exhibits, hidden transmitter hunt and an interesting program for the XYL. For information write Dayton Hamvention, Dept. 7, Box 44, Dayton OH 45401.

MAKE MILLIONS? Hundreds? Sell Instant Gourmet Kits (eight herbs and spices in beautiful red plush wallet) to local gift shops, stores. Dandy gift item for friends, businesses, travelers. Why be poor? List for $5, your cost $26 dozen. Instant Gourmet, Peterborough NH 03458.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St. Oakland, CA 94607. 451-7755 area code 415.

73 Lifetime Subscription

A LIFE subscription to 73 costs $73. By comparison with life subs to other magazines this is quite a bargain. With inflation going the way it is, and no hint of it stopping, plus the unending raises in postal rates, that $73 could be gobbled up in a very

of all amateurs, but not disconnected from the brain of those amateurs. Wayne feels that the League should take complete responsibility to see that no legislation is passed that is detrimental to the will of those individuals represented by the League. And he has expressed many more such attitudes that make him rank high with amateurs in general.

So the thought occurred to me that if the League is failing so miserably in its duties, and Wayne Green can see these failures and pinpoint them, why not replace the general manager of the League with Wayne himself?

Fantastic, you say? Not really, if you think about it. For years, concerned amateurs have been writing Wayne, asking that he do something to help save amateur radio from its downward spiral. If he would accept an appointment by the League directors, this would provide the ideal means by which he could help. Instead of giving lip service to the duties of the League, he could get in there and make it happen.

There are 16 directors. If a quorum of them got together, they could fire John Huntoon and draft Wayne Green. As an active amateur, an experienced leader, and a concerned member of the League, Wayne Green would not refuse to serve.

I mentioned my thoughts to Wayne. The whole idea, he said, was almost incredible. Of course he'd serve, but the problems involved would be manifold. What about 73, for example?

Well, what indeed! 73 and QST could be combined. The problem would certainly not be insurmountable. When you get down to the nitty-gritty, you see that if as few as nine directors decided that Wayne Green could do more for amateur radio than John Huntoon, the switch could be made. . .that quick!

What do you think?

yentional tone frequencies in use for amateurs are 1650, 1800, 1950, 2100, 2250, 2400, 2550, 2700, and 2850 Hz. Before adopting any frequency, be sure to check the frequencies in use by other repeaters within your operating range.

Repeater Directory. The April issue will be spotlighting FM. Naturally, last year's repeater directory is out of date by now, so we'll be publishing a whole new one. We want it to be as accurate as possible, so if your repeater wasn't listed last time, send us the details *now!* Give us call sign, in/out frequencies, tone requirements, etc. Don't wait, because it will be another year before another directory can be published. This is positively your last chance to have your repeater listed. Don't put it off any longer.

New Books

Canadian Amateur Radio Regulations Handbook, published by the Canadian Amateur Radio Federation, P.O. Box 334, Toronto 550, Ontario, Canada. Price $2.55 postpaid.

Of special interest to amateurs in the U.S. is the section on non-resident amateur radio operators who are planning to visit Canada.

Certainly every Canadian amateur should get a copy of this complete guide to Canadian regulations. Despite the low price, this is a big fat book; a good buy on poundage alone. Canadians can be proud of the job that the CARF has done on this book.

HAPPY NEW YEAR

FROM ALL OF US AT 73

. . .K6MVH

SLOW-SCAN

by W2NSD/1

Ron, of EKY Video Vision (the EKY is from W2EKY), stopped up at the 73 HQ and demonstrated his new SSTV monitor unit. This is a complete monitor using his circuit boards and selling for $298 in complete ready-to-use form.

We watched a demonstration of pictures sent on 20m and were favorably impressed. While Ken and I do not quite share Ron's enthusiasm (he believes that SSTV will be as popular as SSB in a few years), we do think that it is bound to become popular, rivaling RTTY perhaps.

It takes eight seconds for each picture to come through, so it isn't exactly moving pictures. And by the time the bottom of the picture is being scanned the top of the picture is fairly well faded out, even with the long P7 phosphor of the scope tube. Still, if you shade the tube you can see the picture. It has about 120 lines as compared with 440 for commercial television, which reduces the definition somewhat (like about one-fourth) and the picture is made up of black and greens, with no shades of gray, which further reduces the definition.

The two main methods of sending the pictures are either through a regular television camera with one frame being used every eight seconds, or by a flying-spot scanner. The camera can send live pictures, albeit nonmoving. The scanner sends only photographs and drawings. The scanner has the advantage of being a lot less expensive to hook up.

few short years. Early life subscribers to 73 have already saved a bundle.

A few fellows write in worrying that they might not live long enough to make it worthwhile. Let's ignore the fact that a life subscription to 73 seems to be one of the best insurance policies yet devised . . .out of about 600 lifers we have had but one die. One in ten years!

73, as just about anyone who has visited our offices will testify, is a philanthropic enterprise. The top staffers here all could make far more money working at other jobs, but are devoting their life to the magazine because they feel that it is important. Your life subscription to 73 helps out. It helps us to be able to run more pages in the magazine. . .it helps us to be able to put a few more iron curtain hams on the gratis mailing list. . .and it tells us that you like our work and have confidence in us.

If you have a spare $73 around now, the chances are that you have provided for your family and that an extra ten or twenty dollars are not going to make much difference. You are gambling with the money, but even if you lose you win in the long run for your money will be well used. Can you ask much more than that?

When you reach the next world the important things will be those acts of good that you have done. A life subscription to 73 is not going to hurt one little bit when you are trying to balance out some of those rotten things you've done. Invest in the future, either way, with a life subscription to 73.

LETTERS

HOMEBREW FM RECEIVER

A number of hams in this area have been trying to design a multichannel, solid-state, 2 meter FM mobile receiver. We have expectantly watched 73 Magazine for construction plans, while burning out transistors and ICs in our own experiments. We recently purchased a number of surplus 10.7 MHz i-f strips and would hope to utilize them if possible. Any consideration given by you or your staff to this problem would be greatly appreciated.

Don WAØYFI,
59 Morningside, St. Paul MN

We have several receiver articles currently "in edit," one of which is an extremely sensitive and stable unit that is microminuature.

HOT TIP

Having trouble burning the cord on your soldering iron by brushing it with the hot iron tip? Wrap the cord with Scotch number 27 glass tape; this tape is also good insulation for cords in places where the wire may be exposed to heat.

Orville W5PGG
1435 King Clarksdale MS

Charlie (photo) is presently active on all bands from Yaounde, Cameroun, West Africa. He is from Briston, Tenn., where he signs K4PHY. He has also operated as DL5IX and K4PHY/YV5. He plans to be active from Yaounde for at least two more years.

Les K42CP (TJ1AW QSL Mgr),
Box 626, Hickory NC28601

The only hope of those against incentive licensing is to support Wayne Green and 73. Mr. Green is cognizant of what this unpopular regulation has created for the amateur and he is making an honest conscientious effort to change it. My immediate concern is not with his earlier affiliations or proposals but what he is doing now. He has a horrendous task of bucking a million-dollar combine such as the ARRL but his determination and tenacious fortitude should make him a formidable and respected opponents. With the radio amateurs' support I believe him capable of bringing about beneficial changes to the radio amateur service in spite of the ARRL's irresponsible do-nothing attitude.

Harry W2SAD,
196 Madison, Mt. Holly NJ

Now let's get down to brass tacks. "Why don't you get yourself nominated? (it can be done) and run in the fall ARRL elections."

I think you have an excellent magazine —,especially with its many technical articles, but the constant arguments with ARRL I don't believe is helping much. Maybe you'd make a good balance on the board. Then maybe you can do something, but just the constant hammering with words hasn't done much good.If you can't get nominated over in the East come on out and run in our district.

Your staff has certainly written the most qualified series on obtaining higher license. I am certain I (totally disabled) would never have obtained my Advanced class license without the study series. I learned even more than was necessary to get the ticket. I am a member of ARRL because I believe I can have more effect in than out. Come on Wayne — more action will help quench the sarcastic officials at ARRL.

Hank WA7JAQ
1324 W. Knox, Tucson AZ

Australia has a ham dropout problem too,& again I regret to say that SSB is the problem. The young ham works locals on 40 and 80 meter AM phone, and wants to work DX. He can't. Not on AM anyway. He can do it on CW, but many of them don't. And you have to have SSB on 20m. So, the young VK ham as 3 choices. He can spend at least 10 weeks' wages & buy an SSB rig. He can build an SSB rig. He can forget the whole idea. Some buy gear. One or two build SSB rigs; the rest just fade away. The young hams with financial problems quit.

SSB is progress, and we must have progress to survive. Illegal CB DX on AM is a problem here, as it is in the USA. As long as it is the only DX you can work on AM phone, it will continue to be a problem. Maybe we should force CB into SBB; one in — all in! We have the problems; does anyone have the answers?

John Smith VK31Q.Victoria,Aus
Victoria, Australia

Here at work three of us get different U.S. magazines which we then swap around. In the latest 73 to arrive there appeared an article "What's happened to Hamdom". My congrats to the author as he appears one of the few ready to speak up in favor of QRP. As an outsider may I comment that the answer appears to be in educating the newcomers, the Novices, & anyone who will listen that high power is not necesarry.

Educate them to join the QRP ARC (and I am not a member) whose members will not tolerate more than 100W input (CW) and 200W PEP. They believe, too, in homebrewing their gear & then dragging every erg possible out.

I have never used more than 65W but it has scored me 187 countries! OK, so we don't have the numbers that the U.S. has to content with but finding a blank spot in the spectrum is just as detect radiation by radar, ultrasonics, magnetics, etc. There are echoes to the effect that even kings and queens are interested in UFOs.

R. Hervey,
50 Croftend, Glasgow, Scotland

Our ham national league is having some big trouble now, and this has been taking all my available spare time for the last few weeks. (We have a local Huntoon, I'm afraid).

Anyway, I hope to have an article soon with an interview with one of our telecommunications authorities.

Flavio PY1CK, Rio de Janeiro

ARTICLES

Your article, "A Low-cost RF Wattmeter" on Page 72 (Nov. 1970 issue) at the top of second column after the word assume, should be "4W is full-scale meter indication in watts". I changed "reading" to "indication" because meters do not read; people do.

W.H.G.,Box 24, Richlands VA

You'd better change it back; Webster and I agree that "reading" is a noun that means "data indicated by an instrument."

. . . Ken

Though 73 is an amateur radio magazine that normally costs a dollar a month it is vastly superior to anything offered by its British counterparts even though these are somewhat cheaper. The broad exchange of ideas and ample technical material coupled with the relaxed style so typically American is very good value. I am even doing some restudying by following your study series.

B.G.E.,G3RJX,213 Perry Wood,
Great Barr,Birmingham

I simply could not believe the mistake made by K1CLL on page 36 in the Nov. issue! This is a classical error; when you use one-half a centertapped transformer winding you do *not* obtain one-half the impedance! In his article he uses half of a 125

that has existed in our hobby for too long — a lack of communication!!

Keep on printing all those letters to the editor. Especially like the idea of printing the writer's mailing address — how many times I've seen letters and thought "Boy, I'd like to tell that guy a thing or two."

The Amateur Radio News Page is good. General magazine layout is improved also; but why not group all the ads together in one part of the magazine?? Think most hams read the ads as well as the articles, in some cases more so. Would make it easier when I wish to refer back to an ad if I didn't have to page through the whole magazine — the Ad Index helps here but I can't always remember the advertiser's name, sometimes just a particular product I want, which may have little relation to the advertiser's name. Your gang is doing a good job.

Larry W7FOQ,
Box 345, Moro OR

Your editorials and comments by your other writers are great. I want to write a long letter but don't seem to get the time. I do feel that a registered lobbyist in Wash. D.C. is important. I agree completely with the comments re CB made last month by the K2 on your staff.

Howard Furst,
Box 246m El Toro CA

I've built almost everything K2TKN or K1CLL have ever written about. The 6 and 2 linear (page 8, April, 1966) is the easiest thing I've ever built, and it's one of the best articles on VHF construction I've ever seen — clear, simple, concise — that's the way Bill Hoisington wrote it, I'm sure. This amplifier, incidentally, works like a charm, and I've built a few for friends without workshops.

Steve WB2WIK

Being about a year behind in my reading, it was only today I read "Light Naturally Runs

SCOPE STAND

Here's a picture of an oscilloscope stand that I find practical. It's the skeleton of a high chair that I bought from the "GoodWill" for 75¢. My modifications are the side pieces and the angle across the back. I'm sure that others will have better ideas for alterations.

I also have bought surplus grocery store racks at the GoodWill to put signal generator & other equipment on, to leave the bench clear for my projects. Just takes patient shopping to find something that the equipment will fit into, and be at the right height.

John W7SCU,
1944 8th Ave,Seattle WA

A NEW LEAGUE

Great going on the license info. When is Wayne going to volunteer to start a new ARRL? Want a donation? I'll pledge a fair sum if he'll tackle the job.

Scott WB6USM

We need a new organization to support our hobby? I personnaly had been thinking along this line for several months; unfortunately, I'm one of the silent majority. I, for one, would be most happy to see a new organization developed.

Also having seen 73 grow from that small underdog to the present day monthly informative, I am convinced that you have the management and intelligence to successfully do the organizing and developing. Needless to say I would probably break my neck trying to get my application in to become the first official member. As for raising the enormous amount of money to finance all of this, well, I'll have to leave that to your fine team or some other ham with a lucrative scheme. How about it, men? Wouldn't your morale be higher if you belonged to a club and could be centrally united to better our great hobby in this universe?

Glenn R. Snow WB9DBC/9
Box 112 Camp Douglas WI

Maybe your suggested approach is right. See "Mr. Virgo Himself" editorial on News Pages, this issue.

...Ken

ARRL is basically a good and highly useful service and amateur organization. It has a tremendous potential which seems to be lying dormant. If all of the hams who wanted to *improve* ARRL would get together by letters and at election times, we could be represented and make it an organization with a real "fraternity" attitude from all its members. Maybe I'm too naive. If this is so, I'm willing to work for forming a new club, but one big voice in FCC's ear would be better than one small one.

Jim WAØKYM,Leavenworth KS

FROM AROUND THE WORLD

It is now about 10:30 p.m. here, and all I hear is QRM on 20m. It is cold outside altho today was warm; almost "shirt-sleeve" weather with 18 in. snow that fell Friday while we were here.

There are many here — HBØXKZ, KQ, SF, etc. HBØXSF is DL4WJ (John Wilson) — we drove up in my VW wagon. He is operating in a cabin and I am fully set up *in* my wagon as you see in the photo. I have TR4, Hustler antennas, heater, stove, food, etc., and sleeping bag. I sit here in back and operate all day & night with ac power from the house.

We are about 5000' here just above the town of Triesenberg and below the Hotel Graflei. HBØXKQ is above us at the Graflei about 1000' higher. HBØXKZ is below us in the town.

The trip is about a 6 hour drive for me. I live in Zweibrucken, Germany, as *DL4VA* and am a civil servant. Home is WA4WME in Huntsville, Alabama. HBØ is not rare any more as many Ds and HB9s come here all the time.

Hugh Vandegrift FØUG

hard whether you're using a KW or a couple of rusty nails.

Most countries of the world use 200W or less & this seems to rock the 4W kids whose reports frequently aren't much better than the QRP station he is working.

GO LOW & have fun. Get the newcomers interested & warn them off QRO & let's get hamdom back into better shape.

Barry Clarke VK5BS,
South Australia

For the information of U.S. DX'ers, Europeans are limited mostly to about 15W dc input. Be a sport and use your cherished linear only if necessary. Consider it this way. When you need it, you have it. And that is a nice feeling. But only use it in extreme cases. Give the other amateurs a chance, and lose the face of the "Ugly American" again.

I was last year working PAØWEJ from a Swedish ship in the Caribbean. I had my wife aboard, and the transceiver functioned more as a social link than a DX gun. So often I was calling "the European station with the weak signal please come again, the other stations please sit by." The "Ugly Americans" came back straightaway, 40 dB over 9. Plenty of them. It is difficult in these circumstances to maintain politeness. This happened so often that I winded up by calling "please, only Europe stations, no American stations." This is what American hams are doing! In Europe they have a saying which goes like this: "The one who fits the shoe, puts it on." Although it loses much in translation, the meaning is probably QSI'd by most of you. I would be pleased if 73 would print this as an opinion of a Dutch, but morely a European ham.n.

W. deVries PAØWEJ

I'd be interested to know about apparatus used by UFO experts in the U.S. How do you

ohm winding and says that the impedance obtained is 62.5 ohms. Not so! The correct value is 31.25 ohms (one-quarter of the total impedance). *Please* print something about this. I wish I had a dime for every time I have seen this error — I would be a rich man!

Clyde Wade, 312 S. Cedar, Little Rock AR.

Back in 1966 when I finally decided to subscribe to a ham magazine, I bought a copy each of QST, CQ, and 73 to see what was best. I have been receiving a copy of 73 every month since then — even though my ticket has lapsed — because of the technical articles on the pages and the light-hearted attitude between the pages. Now how about a "here's how I did it" column? Few of us are qualified to write a full-length magazine piece. Yet we all have some good ideas to share on how to proceed with a specific operation or a brainstorm insight which works well for us. Even if the column never comes to be, orchids, roses, and welwitcha blossoms to the magazine and the dedicated group which puts it in my mailbox each month.

Charles, 7918 Lamon, Skokie IL

Looks like your Printer's Devil has been exorcised in the current 73 — I coldn't find a single transposed line, misspelling, or error of any kind. Tight editing for which many of you will share the credit. Nice going!

Jake WB2PAP, Stewart AFB,NY

We're verry carfull about such things.

EDITORIALS

More W2NSD, K6MVH, K2AGZ. More W7ZC, K1YSD and any others that will stimulate people to think. By presenting these writers and their differing opinions you are going a long way toward filling a void

Down" by K1CLL. Really interesting! Can you run some more like this? If you do, please use some sort of eye-catching device — so I read it right away!

John WA2LJK

How about us printing a personal note to you on the front cover?

FREE SPEECH

The "free speech" controversy brings to mind an incident of several years ago. I lived in a small town, and we had (don't most small towns?) a swimming hole. We got a new minister in our church who was young enough to enjoy life with young people. One day he and I went swimming, and were recognized some distance away by the local tough guy. As we approached, we heard some of the most vile talk imaginable. We came within speaking distance and Mr. T. G. said "I didn't recognize you, Reverend, or I would have been more careful." I never will forget the answer. "You talk any way you want, but I don't have to answer you that way." The next Sunday Mr. T. G. started a habit of church attendance, and his everyday language improved.

I think we should all be guided by our knowledge of what is socially acceptable.

Lester WB4HPB,
Box 5153, Birmingham AL

Even though I am a 16 yr. old, 6-month Novice, I am also an activist. I concede that I was late in sending the coupons (they're great), but I finally took the time tonight to mail them all. The sudden reason was an attempt to get on 40 meters which became so sickening I gave up. I hope I'm not too late.

I think your editorials and news pages are fantastic, especially Ken's in the Nov. '70 and also George's (W4PZS) on the League, etc. It also helped me to decide to write this letter. I don't like the 220 MHz idea at all. Can't win 'em all.

Paul WN1MPY

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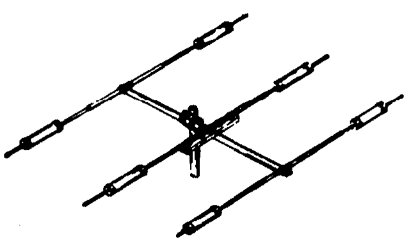

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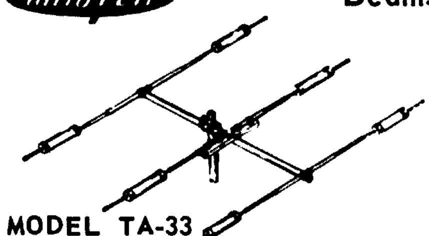

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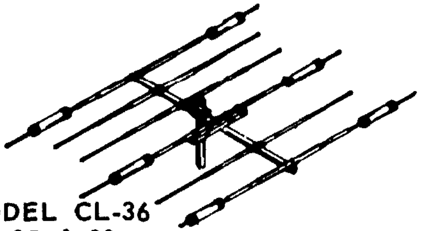

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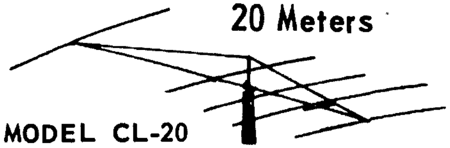

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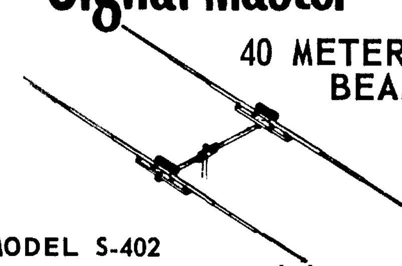
75/80 meter coil	MD-78
Matching Network	MD-48

Signal·Master 40 METERS BEAM



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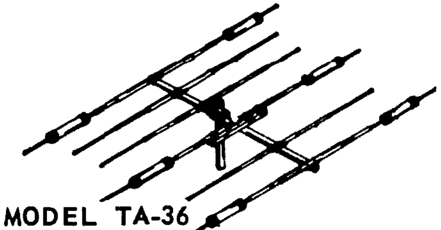

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VIETNAM

On behalf of the entire Army Mars Station, AB8AQ located in I Corps Vietnam, I would like to thank you for sending us your publication. Being in the northern section of the country we seem to get very few magazines or newspapers, and are always grateful for any periodicals we get. But working in the Mars Station and being a former ham myself, it is particularly enjoyable to receive your magazine. Mr. Alex Scherer, W9EU and A9EU, wrote us and reported that you had sent us the issues. And we do want to thank you for them.

All of would far prefer to be home, and in less than a year we will be. But while anyone is so far away from home it is always a comfort to know that someone back in the States is going out of their way to make our time spent here a little more pleasant. Once again we say thank you.

AB8AQ 8th RRFS
APO S.F.96308

Our station received your 73 Magazine yesterday. We would like to thank you for thinking of us GIs over here in Vietnam. We will be looking forward for the November 73 Magazine along with QST. The magazine will be a great help to us over here in trying to get our general ticket, so when we get back to the States we have a better understanding of basic radio theory. Most of the personnel in our station are trying for our general ticket, so 73 Magazine along with QST will help us toward our goal of being in league with the hams all over the world.

Tony, Mac, and Petty **AB8AAV**

We got your copy of 73 and we enjoy it much. I find it as helpful here as I did when I got it at home. We all want to thank you much for the copies. Also for the great work you are doing for us over here. My greetings come from not only us here on the station but from all U.S. servicemen here in Vietnam.

Larry **AB8AAS**

I do not think the 220 band should be used as a refuge for CBers. We all know how the well-intended CB program exploded in complete chaos. I would hate to see the ham bands exploited in the same way. Also, this thing could start a trend which would eventually result in a merger between amateur and Citizens Radio. CB was never intended to be used for what it is being used for today but nevertheless, it is being used for a "ham" band for persons who are too lazy to study and become a legal ham. In our society there are certain individuals whose aims are to corrupt or destroy whatever they can, to see how much they can distort something. We find a large percentage of the CB population are these type of people. Have you listened to the CB band lately? What do you hear? I hear pseudonyms instead of call signs, operators boasting about the performance of linears. Do you think these individuals will reform and become decent members of the amateur fraternity? Will they give up that linear to become a "hobby ham" or will they carry their present ways into the ham bands? Will we see the 220 band evolve into what the 11m band is today? If it does, perhaps we could give them part of 40 or 80m. In my opinion, such an idea would only attract the somewhat undersirable portion of the CB population, not the legal users. The CBer who uses his rig for business or personal use will stay on the CB band. Why invite trouble into the ham bands? Why chance earning the same reputation that the CB band has after spending years building the one we have? Another point, would the band be self-policing? If so, why isn't the CB band self-policing? Why would a CBer who is using the CB band illegally suddenly become conscious of the existence of the rules? Concerning the proposed test, I think that any individual who is seriously interested in radio as a hobby should be able to pass the General

Your comments recently in 73 about the general public not knowing the difference between CB and ham operators sure hit home with me. I have found so many times that the public has no idea of the difference. Even my wife didn't know the difference until after we were married!

Cal W9ZTK, Mendota IL

I also sincerely doubt that the present "better ops" on 11m would move to 220 MHz. The decreased range from base to mobile would discourage most of them from making such a move. Our 6m band has been self-policing to a large extent but let's not be giving the CB'ers credit for this as this is a ham band. I seem to get the idea that we should move all the "good guys" to 220 and let the present chaos continue on 11. What assurance do we have that only the "good guys" will move to 220 and who is going to determine whether he is a "good guy" or a "bad guy"? With the present growth of CB'ers it seems to me that for every one that moved to 220 he would be quickly replaced on 11m.

Bob **WA0PVM**
5544 Blue Ridge, Raytown MO

I've been thinking about this ever since I read of your proposal of the "Hobby" band. I think this should be revised. Many people would still use 11m for DX. The best way to alleviate this problem is to push for the removal of the CB band from 27 MHz and move it to 220 MHz. Then take the hobbyists and put them on 27 MHz. Amateurs could use this band also as a police force and also to help convert these hobbyists to ham radio.

Rick Brown **WN0ZQX**

I would be grateful if you would print that an SB-33 was stolen from my car on Oct. 17. Identifying features are: serial number 103327; meter face is illuminated by a square of light that lights up only the center portion of the meter scale; also the additional requirements you suggest. With the majority of us "pirates" it's not the money, but the pleasure of hamming; we are prepared to pay for reliable equipment.

J.C., Melbourne, Australia

The Hobby idea is outstanding. Something must be done about the conditions we are now putting up with on the 27 MHz band and this is one way to do it honorably. It might seem to be hams that this is the easy way out for the FCC but doing it this way a lot of "Good C Beas" won't get put out of business for the actions of the skip-talking crowd now on 27 MHz. Many have great interest in radio but are afraid to tackle the chore of being a ham because they hear it is hard to pass the test and that the gear is expensive. Allowing this type of individual to take advantage of the proposal made by FCC he would be broken into radio the right way instead of being suckered into the mess on 11m. Once on the band and with no fear of the FCC the operator can relax and enjoy himself, he can maybe even join the local ham clubs and be able to see the true picture of full advantage of upgrading to higher class license.

David McCallum,
Box 193, APO S.F.

I am in support of the Hobby class license — especially the frequencies involved. I would hate to lose it like we did 11m. I hope that maybe we can get the ARRL to support it in which more attention would be given by the FCC.

Darwin **WA0HEY**,
Box 160, Belmond IA

I have been thinking about RM-1633 and the more I think about it the better I like it. One thing I have wanted to do in the past is talk home to my wife while driving home from work. Like most women, she is not interested in learning code or electronics, so there is not much hope that she will ever get a

1011 fiasco among other things. He and I know the thinking behind its introduction.

Too bad you fellows up in the Northeast don't get the word! Or are you pressed for something constructive for your column?

Do us serious hams a favor, will you? Hold the B.S. down to one page so there'll be more room for tech articles.

John Conley **W7ZFB**

Okay, John, We've got it down to one page now. But you might need a magnifier. How about a foldout next month? hmmm. . .
. . . Ken

I have a Collins KWM-2 transceiver which will operate on the 11 meter band without modification. What's so unusual about the Swan?

Bob **WA4NXC,**
949 1st St., Albermarle NC

The Swan editorial is surely misplaced. It either belongs in the April Fool issue or in the CB magazine. No intelligent amateur would either write or believe in what you had to say. The name calling you did reminds me of what K6BX had to say to Kennedy Space Center ARS a while back. So I will put K6MVH in the same category as most have done that lunatic from California, even though I had previously thought he was well known and liked in FM circles. Concerning the Swan 1011: What amateur in his right mind would spend that much money on a rig that works only on a band that will be dead soon? The last time 10 'went dead' they even made rigs without 10m capability. What amateur in his right mind wants to listen 30 minutes to a guy with call letters "Mickey Mouse" to find out how far away he is, so that he can go operate on 10m? Let's face it, there is more money in the illegal CB market than in the amateur market and Swan wanted to take advantage of it. I bet you don't write in your CB magazine that only one

HOBBY LICENSE

I am a college student in the bay area and have listened to the progressive degeneration of CB over the last year. The channels are jammed with assorted heterodynes, carriers, snickers, giggles, linears, skip from the east, "news reports" by right, left, and otherwise radical groups, and Part 15 communications, obscenity, and almost anything imaginable. The exchange of operating specs between two stations seems lily white compared to the flood of misuse. I was considering going on the band, but cannot in good conscience add my signal to the witches' brew. It would be useless and self-defeating. The Hobby band proposal is heroic, I feel, and I offer my support to whatever supporting efforts are needed for the proposal's passage. If the fertile area of VHF can drain off the serious CB hobbyists, the band could be left to the FCC and the nuts, then to legitimate uses once the deadwood has been cleared out. It is true that some CB hobbyists go on to Novice; others, like myself, are totally disinterested in code and resent the inroads into phone requirements. SSB has closed the CW AM DX disparity, and I think that an interest in radio construction and propagation should be the only requirement for ham licensing. Naturally, I do not want to force CW out of amateur radio, but I think that the 220 band can be used for strictly hobby, with a rules and even a theory test, possibly as hard as the General theory exam. The world of VHF is exciting, as exemplified by the DXpedition recounted in QST where new records were established on 1000 MHz (okay, so it is UHF, it's still exciting.) I hope others feeling similarily will write the FCC as I have done to encourage the proposal.
Mike Robison
504 E. Hilldsdale, San Mateo CA

Re the proposal for a Hobby license for the 220 MHz band, the idea of phone only was quite natural considering your pronounced prejudice against CW. Your desire to increase the activity on 220 MHZ is a laudable one. I had been toying with a similar idea for the last two or three years. It was prompted by the almost complete lack of activity on the 220 band in this part of the world. My suggestion was to open the whole 220 band to anyone with a special class license. No phone would be permitted, but these new hams could start by sending code to contact other people. Instead of practicing at home on a key and copying meaningless code, which becomes a chore and a task, have beginners practice code by actually sending to one another or to a legitimate ham. The equipment would have to be certified by the FCC, so that commercial equipment would generally have to be used. It would be crystal-controlled. It would be installed and checked out by a qualified Extra-class radio amateur. The idea behind the whole thing would be to create interest in code by actually communicating, populating the band, and yet have quality transmission. But only CW! The phone portion of the transmitter would be disabled and sealed. I think 220 band would be the ideal band for a learner. exam. If he is going to use vfo's and experiment with equipment, he should be able to demonstrate that he possesses the necessary fundamental knowledge of basic electronics.
Ron WA9YUJ,
Box 71, Albany IL

Joe W8FAZ,
1227 Addison, Cleveland OH

73's recent proposal for a no-code license for 220 left me cold, so I must do the same for you as regards renewal. This is the first ham magazine I have dropped, so you can see how I feel about the 220 proposal.
Dick W9QWT

an electrolytic in the power supply is held in place with a piece of blue nylon monofilament fish line. If located, please contact me at 617-527-1346, or Newton Police (617-244-1212).
Eric K1NUN,
41 Prentiss Rd, Newton Ctr MA

Sorry, we don't print that kind of info.

I am a "pirate" and if you haven't already thrown this letter in the wastebasket I would be obliged if you would accept my congratulations for Wayne's practical proposal on page 10 of the July 73 regarding Hobby licensing. Typically, I suspect, I am a family man in my early 40s with a few dollars to spare but with a limited knowledge of radio, therefore "CB" (?) is the only way to have a go. Station procedure is relatively simple but the theory and practical takes time, especially if you haven't had any past experience with electronics. Frankly, I don't enjoy being a "pirate" and I am certain that my many friends don't either. With a Hobby license we could buy decent commercial rigs, and proudly erect that dream antenna instead of operating our clandestine stations with small portables and makeshift whips. Legalizing would sort out the genuine operators from the frivolous lads. Unfortunately, in Australia the only "CB" channel available is 27.240 MHz with a 1 watt maximum, so you can imagine the mess. Instead of your 220 MHz amateur band we have a 420-450 MHz band, however few of our amateurs use it. Surely we could use FM equipment on part of our 420 MHz band in the same basic manner as Wayne has proposed. In my business I run a licensed VHF-FM station with mobiles and all that is basically required to go on the air is the rig and the license fee. It seems reasonable therefore to propose a similar procedure here for Hobby Class licensing with, of course, regular ham license. The Hobby license would be just the thing. I hope RM-1633 is adopted because it will allow hams to do this type of thing (which now can be done only with CB). RM-1633 will increase the versatility of ham radio.
Roy W5PAG,
4748 DeBeers, El Paso TX

SWAN SONG

I just finished reading "Mr. Virgo Himself" editorial in November issue. I can't say that I agree with you when you said that we should feel ashamed of ourselves. It seems to me that a company the size of Swan would do at least a little market research before spending a lot of money on a project such as the 1011. I think that we are not as guilty of a shameful act as Swan is of making a mistake. The fact that Swan discontinued the 1011 is worthy of attention in that "ham opinion" was taken into consideration. If "ham opinion" is blamed for the discontinuance of the Swan 1011, perhaps we could use our pens to help bring the cost of the tools of our hobby down to a level where that cost is not a major stumbling block to would-be amateurs. Right now we are trying to get more youngsters interested in ham radio. When they look at the cost of new equipment, the impression is that ours is a really expensive hobby. This stops a lot of them cold, or worse yet, turns them to CB where equipment is traded more often and is available at lower cost.
Bob WA8IMO,
230 Moore, Avon Lake OH

I seldom write letters since I'm primarily interested in tech articles and the rest be damned, but when I read the (Swan) garbage, I just had to drop you a line. That had me rolling on the floor, clutching my sides. I'm giggling as I write this.
By the way, had a nice QSO with a Swan employee couple of weeks ago. We discussed the in two hundred CB'ers has the knowhow to modify the 1011. The ad said that the transmit function was simply left out of the relay switching circuits, the rest of the electronics is already built in for the CB mod. I agree often with your magazine's criticism of the ARRL and believe you recently mentioned their deaf ear or something to that effect. Your filing of comments concerning the 1011 in the wastebasket is typical of ARRL nonobjective thinking. I sincerely hope that I have made my point; I don't often waste time writing nasty letters and I'd rather spend it reading the many excellent articles in 73.
Ambrose W4GHV
538 E. Sanford, Auburn AL

May I offer a mild objection to your editorial in November 73, which concerned the pressure on Swan to discontinue production of the 1011 transceiver? You say the CB'er could not modify the 1011 for transmit use on 11m. They wouldn't have to! Amateur Electronic Supply of Milwaukee, Wis. already has the unit listed in their catalog, "modified by AES to transmit on 11m for use outside of U.S." I see the same relation here as selling illegal drugs. It's like saying "let me sell you this dope, but it's illegal to take." I believe one of the things a ham has had to be proud of is the custom of doing police work on his own bands. I think this is what has been done in the Swan 1011 case. I do not believe this was the intention of Swan. I have a Swan rig and can vouch for very fair dealings from these people. However, they have in the 1011 a ready-made (minus a few "special modifications") illegal CB rig to be added to the already too-long list being promoted by money-hungry dealers.
Gene WA5ETK,
Box 381, Texico NM

(More letters: p. 108)

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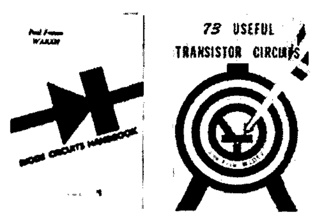

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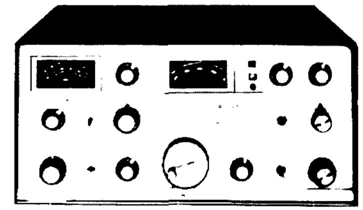

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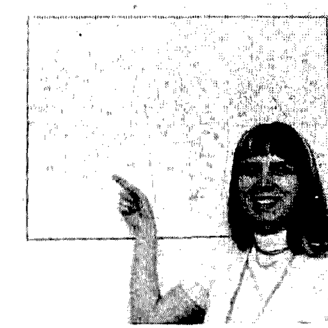

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LX for Leisure

If you would like a leisurely vacation with a bit of amusing radio operation thrown in, you might consider Luxembourg.

The Grand Duchy of Luxembourg is a small country right in the middle of Western Europe. It has frontiers with Belgium, Germany, and France. It is an independent country but maintains a currency union with Belgium, which means that 1 Belgian franc equals 1 Luxembourg franc, and both Belgian and Luxembourg currency circulate freely in Luxembourg. Note, however, that the reverse is not true. Luxembourg francs are not so readily acceptable in Belgium, so visitors are recommended to change their Luxembourg francs into Belgian francs before leaving Luxembourg.

The country is also part of the Benelux Customs Union.

For so small a country it is quite surprising what a large variety of different types of scenery, of ways of life and even of activity, it represents.

The country is far from flat. While it is not mountainous in an alpine sense, it is very hilly and has many beautiful valleys and rivers, as well as the high plateau.

Its activities vary largely.

In the southwest is the large modern steel industry. (Luxembourg is the center of the European Coal & Steel Community). The capital city celebrated its millenium a few years ago, from which it will be clear it is a very ancient city with architecture and ruins covering many centuries. Perhaps the most remarkable feature is the very deep valley of the Alzette which divides the city into two parts, with steep cliffs overlooking the valley and where many of the medieval fortifications were built.

Further north the country varies from agricultural land to the large artificial lakes created by various dams on the rivers.

The main roads are good and fast. The minor roads are good and slow. Here is some of the most delightful leisurely motoring one could wish for with the well surfaced but narrow roads winding up such lovely valleys as the Mullertal along the Entz-Noire river in what is called Luxembourg Switzerland, the Sure Valley, the Moselle Valley (don't forget the wines).

The valleys often end in steep climbs on to a high plateau with magnificent views for miles in all directions.

The food is good and abundant. Both French and German wines are available – try the Luxembourg wines grown along that stretch of the Moselle which flows in Luxembourg.

So far this reads like a travel agent's pamphlet. What has this to do with amateur radio? Plenty.

Luxembourg grants reciprocal licensing to the USA, Britain, France, Belgium, Holland, Germany, and through the "G" license to most members of the British commonwealth, as well as other countries.

Though Luxembourg is not a "rare" country by real DX standards, it is sufficiently uncommon for the LX call to be much more sought after than a W or a G, or an F or a DL call.

The varied type of country provides quite fascinating differences in propagation. From the high plateaux excellent mobile operation can be obtained to the whole world. WAC mobile could be worked in a day! Descending into one of the valleys while in QSO you may lose your contact completely, or in another valley find you are still in contact! Portable operation from the many country hotels is good fun too.

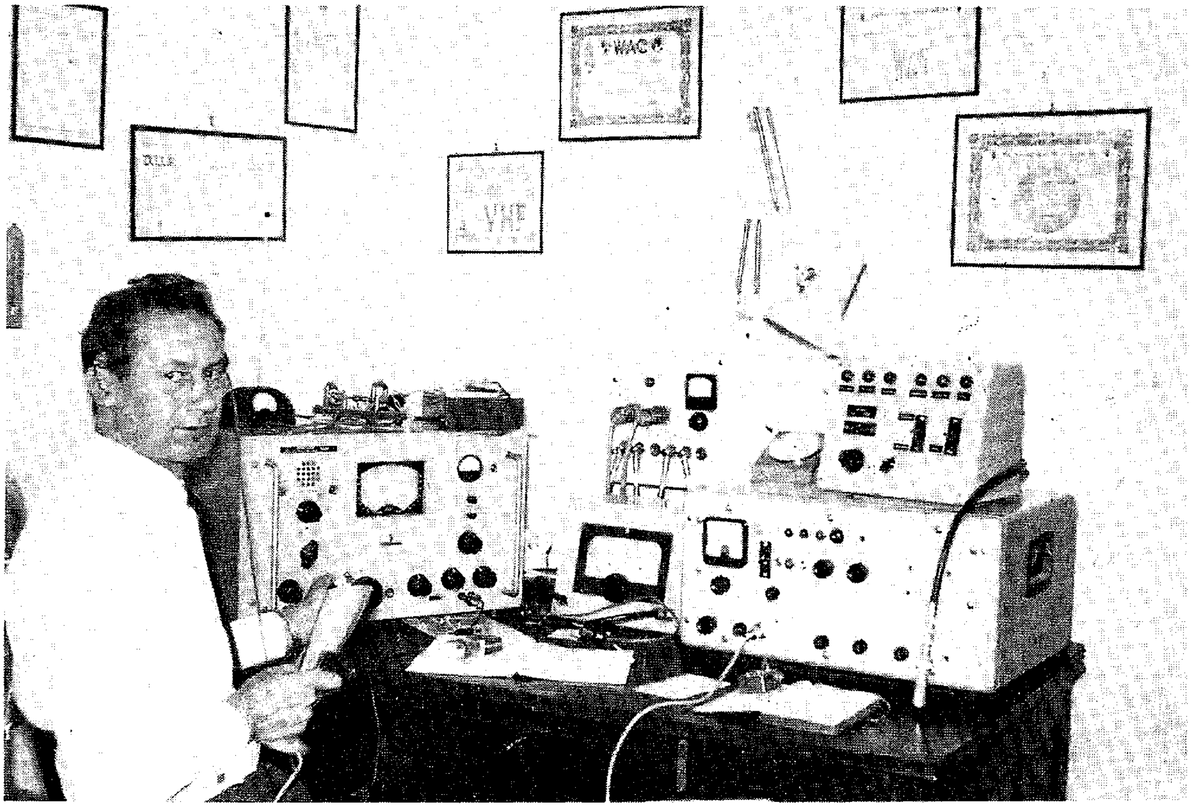
My first portable operation took place at the Hotel Hames at Boulaide in Western Luxembourg. This is a small unpretentious hotel whose proprietor was most cooperative in every way, even accompanying me to a farmhouse next door to obtain permission to put the trap dipole on the farmhouse roof. One of our first QSOs was with New Zealand. He also helped arrange for my battery charger to be connected to the hotel supply to charge the mobile batteries overnight. (But bring your own charger.)

LX1SX at the Boy Scout Jamboree station LX1JAT at Ettelbruck.

Our good friend ON4PG came over from Arlon to visit us and help with the antennas.

From there we decided to try a different location in Eastern Luxembourg where at Berdorf the Parc Hotel was also most cooperative and other antennas were

LX1SL operating at Niederanven near Luxembourg airport.



LX1SI of moonbounce fame at his station at Luxembourg airport.

erected, including a mobile whip out of the hotel window working first against a quarter-wave of wire, and then against the lead roof of the hotel. Japan was worked by both methods.

It was on this occasion that my good friend ON4PG was killed in a motor accident. But not, as some rumors had it, while he was operating mobile. He did not even have a rig in the car when the accident happened.

In 1968 we went later in the year – in October. We were lucky, both with the weather and the DX conditions. We went to Beaufort in Eastern Luxembourg where the Hotel Meyer allowed us to put up three antennas: a trap dipole, a Cushcraft Ham Stik Dipole for 15 meters, and a Mini Products coaxial vertical dipole for 10, 15, and 20 meters (6 meters is not allowed in Luxembourg).

The results were most interesting. We worked into VK, ZL, and JA most mornings and the States and South America mornings and evenings. Although the hotel had a forest of TV antennas and was receiving programs from Germany, Belgium, and other places, no TVI complaints were received.

So far only HF and LF communications have been discussed, but Luxembourg is excellent country for VHF activity. Remember LX1SI who made a moonbounce QSO with KP4 on ¾ meters? Here is an advanced and sophisticated amateur who is really knowledgeable on all matters of VHF. Having made his ¾ meter EME contact, he had already dismantled the rig and the antenna, preparing for better things, so I could not photograph this. He is now working meteor scatter on SSB, and has probably made the first meteor scatter SSB QSO in Europe – one with Hungary and one with SV1AB. His shack is impressive but his knowledge and understanding are far more impressive.

Nor should we forget his brother-in-law LX1DC, who put Luxembourg on the map many years ago on AM soon after World War II.

Then there is the charming gentleman who runs the PTT and administers the reciprocal licensing, LX1JW, well known at the ITU and IARU meetings.

Besides the older and more experienced amateurs there is a crop of young enthusiasts coming along. I met two amateurs who had been licensed less than a year.

Both were on SSB – LX1SL at Niederanven (whose photo appears here) and LX1SK, who is a teacher at the Diekirch High School and organized and ran the Boy Scouts Jamboree on the Air Station at Ettelbruck with a Galaxy V

Reverting once more to VHF, Luxembourg's situation and the high plateau location enable QSOs to be made on VHF with Germany, France, Belgium, Holland, Britain, Switzerland, and many other European countries. While I was there we experienced a temperature inversion which produced VHF DX in several directions. LX1SI was active on SSB on 2 meters when I called on him.

Above all, this variety of scenery, this variety of radio conditions, this variety of form of amateur activity can all be enjoyed in a leisurely fashion. The distances are remarkably short. It is but a half-hour's run from beautiful Mullertal to the capital city, or from the high plateau – with excellent propagation of the region around Vianden or Boulaide – to the deep gorges of the Sure or the Entz.

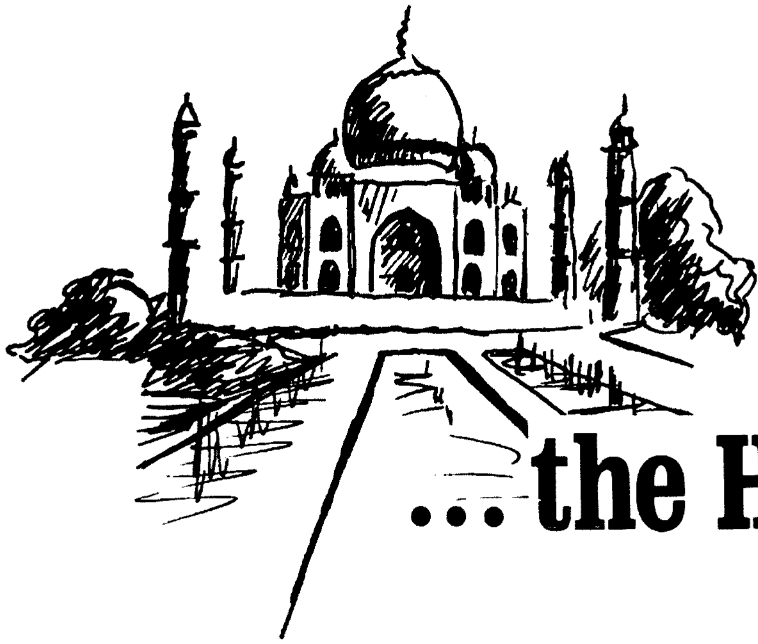
The hotels in many of the little villages are good, and one's nights can be spent away from the noise of traffic and aircraft and the fumes of diesel lorries at elevations of 1500 or 2000 ft in fresh air.

The keynote is leisure. So, by logical extension, as WX is a universally accepted abbreviation for weather, LX could be accepted as an abbreviation for leisure.

. . . G3BID ■

The Mini Products C4 multiband coxial vertical dipole on the Hotel Meyer at Beaufort from which G3BID/LX radiated, with the head of G3BID visible in the skylight.

Try DXing the WORLD ...the HARD Way!



Bill Conklin K6KA
Box 1
La Canada CA 91011

The editorials in 73 about an African Safari and a trip around the world gradually got to me. My wife Jo, WA6VEJ, listened to me reading about the plans and said, "Why don't you go?" After talking with Wayne and my travel agent I could see that it would be almost impossible to get all of the visas needed in the few weeks remaining.

Jo brought me right out of the letdown by saying, "Well, that's too bad, why don't both of us go a little later on?" And there went thirteen kilobucks!

We looked over the weather for each place we wanted to visit and decided that our best compromise would be to go westward, starting in winter.

I had in mind getting on the air from as many of our stops as possible, using local equipment, as Wayne had advocated. An on-the-air discussion of the trip brought an invitation from Trevor (ZK1AR) to visit him for a few weeks in the Cook Islands and help put ZK1 back on the air in style. The license turned out to be no problem, but the visa was contingent upon our getting confirmed reservations out of Raratonga; but, as I found out, there are no reservations out of Raratonga. They have a six-month backlog of people wanting to leave and that is a long waiting line. Well, so much for ZK1.

Letters to embassies were sometimes answered. Some countries would allow me to operate, some wouldn't. India takes 8–10 weeks to grant a license. The Australian license was $A2.40. I considered stopping at Norfolk Island to operate VK9RH, but then I heard that two other ops would be activating Norfolk so I decided that our time might as well be spent elsewhere to better profit. The Russian embassy was hesitant at first, but then an agreement reached by the IARU in Yugoslavia paved the way and I was able to apply through the ARRL and get UI8KAA/K6KA in Tashkent and UI8KBA/K6KA in Samarkand, complete with street addresses and signed by UA3AF. This whole thing took many

letters and phone calls to accomplish. I suppose I should have known that it was really just a big runaround, but I was optimistic. Uganda and Iran came up with permission to operate, so things looked encouraging.

Should I take along a rig or plan on using existing equipment as Wayne did on his trip? After mulling over the problems involved, I decided to leave the gear at home and do the best I could in each country. The cost of carrying along a transceiver plus all the accessories I would need to meet the conditions in a couple dozen countries was prohibitive. The rig would have to be able to operate from about 90 to 270 volts at 40–60 Hz. Then I would need antennas, a tuner, and spare parts. It was just too much. Getting all that stuff through customs could be an expensive bore and I could just as well find myself in a position with the equipment sealed in a customs locker in one town where I had entered the country with me wanting to leave from some other city. If I had been going specifically on a DXpedition it would have been different, but in just about every place I intended to visit I would find a local amateur station set up that I could use.

Even though we started over six weeks before the trip to get our visas which would permit us to enter the countries we intended to visit, we didn't have them all by departure time and, even worse, our passports were tied up in the U.S. mail somewhere in Los Angeles or Pasadena. Just five hours before our plane left we managed to find the passports by going through 42 sacks of mail at midnight in the Pasadena office. Traveling is tiring even before you travel sometimes.

We stopped off for a breather at Anchorage and then on to Tokyo. After a few days sightseeing we went on to Hong Kong and met Pete Pitt (FS6FO), a CW man, and Tony Willis (VS6FS) of SSB fame. They hadn't heard about reciprocal licensing yet, so I had to just listen instead of operate. Drat!

Tough luck in Borneo too. Hiew Fui Siong (ex-ZC5VS) at the Posts and Telecommunications explained that there were no active amateurs in 9M6 at the time. There was a nice new ham station at Labuan Island, but our luck running true to form; we were there only for a few minutes for a refueling stop. It continued in this vein at Brunei Town when we missed Mike (VS5MH), who was attending an official luncheon during our short stop. My record was kept clean even in Sarawak when we had dinner and visited Ron Skelton (9M8RS) and his wife. Ron is with Posts and Telecoms and this was not consistent with "authorized operations." We listened.

Bali was a delight as a tourist attraction, but it was the same old story hamwise. The Bali Beach Hotel is $10 for a double room and there are 1200 staff to wait on about 80 guests spread out in the 300 rooms. There are no amateur stations.

The most active of the Singapore amateurs, Bob Snyder (9V1LP), was in Norway, but we did get together with Harry Pain (9V1MT) for dinner and the first break in our operating bad luck. Not much of a break actually, since only a few Japanese stations were coming through at the time and not one whisper from the U.S.

In Kuala Lumpur we visited Nara (9M2LN) and his gracious wife Fatima, but again no operation on the air. Thailand turned thumbs down on an operating permit, though we did get together for dinner with John Moss (HS1WF). No luck in Burma either. In Calcutta, Renga (VU2RF) met us and took us to visit VU2DG, VU2HK, and VU2RK. We learned that a tall man and a woman in hiking clothes had been through the Calcutta airport just recently with a letter from the Maharaja of Sikkim (AC3PT) asking them to visit and operate. YA1FV contacted AC3PT a few days later and the DX newsletters mentioned others making contact.

In Nepal we visited Father Moran (9N1MM) at the St. Xavier's School. He was quite excited over the imminent arrival of a Drake exciter and linear to go with his Drake receiver. We operated his old Johnson Viking with an outboard SSB exciter for a little while, but the band again did

not open to the States until well after we had to call it a night. Father Moran proudly pointed out the red sticker on his ceiling which said, "W2NSD/1 was here." The next day, during the SSB contest, a few weak W stations were heard, but nothing was contacted.

In Agra, India, we had dinner with Col. Les King (VU2AK) and Frank Williams (WA6CLO) before going on to visit the Taj Mahal and other palaces in the area. Les had tried to get permission to operate from Sikkim, but had failed. He said that General Singh (VU2US), a member of the Rajasthan royal family, had succeeded in getting permission.

We were unable to find any amateurs in Kashmir. In Afghanistan I was able to locate Fred Vogel (YA1FV) and operate from his station as K6KA/YA for an afternoon and evening. The line voltage in Kabul swings widely and you have to keep one eye on the line meter and one hand on the Variac. Even so this is a poor place for solid-state power supplies for the line voltage can shoot up quite suddenly and wipe you out. The bulk of my contacts were with the neighboring Russian stations and no sign whatever of any U.S. breakthrough.

U18KAA/K6KA

This was sure to be the most exciting and rewarding part of the trip from the ham end. We arrived in Uzbekistan and tried to find the station I was supposed to operate. The Intourist guide said that the school had been destroyed in an earthquake and he would have to try to find out where the station had been relocated. He said he thought he could arrange for me to operate on the last evening of our visit to Tashkent, which provoked me because I had had visions of putting in four or so hours every day during our visit. He brought the Communications Minister to the hotel the next night, who agreed that I could operate as much as I wanted, at any time. He then proceeded to set up a visit to the station for me for the next day for 30 minutes! Another Intourist guide turned up the next night. He had no idea of where to find the station, but we started out in a taxi and, by asking directions along the way, we eventually found it. The SSB rig was similar to the S-line and ran about 400W. There were about ten people present and we got into a technical discussion of the rig which gave our interpreter a terrible time. Eventually they let me sit down to operate. They had a contact all set up with UA4IF and they let me talk with him. That was it! I was absolutely furious, but polite.

In Samarkand the Intourist guide didn't even pretend to try to help me find UI8KBA. The food and water in UI8 disagreed with us and one fellow who had come up with us lost over 20 pounds during his stay. I don't think I found five bites of food a day that were edible. The beer tasted like vinegar and they ran out of bottled drinks called lemonai almost immediately. The toilets in the hotel were mostly broken and running steadily, so this was solved by just turning off the water for most of the day and night. I tuned a receiver and found that they had some way managed to have only Iron Curtain stations, with not a BBC or VOA station coming through. We had to wait three more days at the Tashkent airport hotel waiting for the rain to stop down in Kabul. This was a relatively new hotel, but it did not have a shower or bathtub in the entire building, which was eight stories high. There was just one toilet seat for men on each floor. The light fixtures were coming off the walls and my bed came apart twice during the night.

EP2GF/K6KA

Harry McQuillan (EP2BQ) met us at the Tehran airport and took us to his nice home, complete with swimming pool, up near the mountains. The local power went through 100V drops now and then, taking along diodes on the upswings. Harry solved this with 3B28's. Ebrahim and Mary Nuban (EP2BF) had a cocktail party for us which was attended by many of the active locals including EP2AX, EP2RV, and Gerry McKee (EP2GF). I used Gerry's call during the few hours I was able to get on the air from Tehran. Later that night I took a taxi

downtown and visited Ambassador Meyer (EP3AM) at the U.S. Embassy.

We made a short visit to Lebanon, having dinner with Bill Fells (OD5EL) of Collins Radio. Bob Adams (OD5BZ) was out of town at the time, unfortunately. We drove over to the Syrian border and experienced the same delays that Wayne did while our passports were minutely inspected for any sign of an Israel visit. We forgot to bring along Rasheed YK1AA's phone number so we missed visiting with him in Damascus. We went on to Jordan and found that there was no ham activity there either. In order not to cross Israel we flew first down to Saudi Arabia and then across the gulf of Aqaba, the Sinai, and up to Cairo. From there we flew almost immediately down to Entebbe in Uganda and on a tour up through beautiful Murchison Park and a night at Paraa Lodge. Wayne described this same trip to you a few months back so I won't tell you about all the elephants, hippos, crocodiles and other game which is there in profusion.

Back in Kampala, the capital of Uganda, we found a discouraged Ernie Brice (5X5AU). His Swan was defunct. I wasn't about to be frustrated by anything simple so we attacked the rig with an ohmmeter and found that one of the four diodes in the bridge rectifier lacked a high back resistance. We clipped the rectifier out of the circuit, and the radio worked satisfactorily for the three-day period. I spent as much time as I could on the air, but was limited because Ernie had to be with me and I couldn't keep him or his family up too late at night.

Ernie had a minibeam with old coax, so had put up a separate 15m dipole. Not much seemed to come out of the minibeam on 15 and 20. The dipole loaded on both bands, except after a heavy rain one day. Contacts on 20m were difficult, and phone contacts were very slow, but those on 15m CW doubled each day. Some time was used in trying to make a contact near Philadelphia for some missionaries. The scheduled stations did not appear. The ones we heard could not be raised. After the skeds, I was able to make one to five QSOs at a time, which helped to reduce the pileup QRM on the transceiver. When several stations and their RST reports were sent with a request to QRX, everyone knew that it was useless to call until the whole group had a chance to reply. The key was over the table edge. There was no sidetone, though I could hear my pumping arm whizzing through the air. When the U.S. stations were heard, there would be only one or two at a time and no pileup. There was sporadic-E layer en route beyond Europe. At one time or another the signals covered all parts of the U.S., even in my home local telephone area. The condition was typical for northern hemisphere summer.

Ethiopia, Sudan, Greece

Moving on through Kenya, Tanzania, and some exciting scenes of Africa, we pushed for Egypt. At the Cairo airport, the tourist bureau assured us that everything was calm, that we should not cancel our two days in Luxor and three in Cairo. With the unsettlement in Cairo indicated in local and some foreign papers, we followed an Embassy recommendation to go on to Athens. This meant not seeing SU1IM, and getting into Athens with little chance that the airline communications would get us a hotel room there.

Those who were in Cairo during the next few days, which would have included us, were restricted to two darkened hotels, and had to pack in the dark for a truck ride to Alexandria in the hope of leaving by ship. Ultimately they got out. People leaving Beirut had to take only one bag, leaving the rest behind.

Athens was wonderful. There were cucumbers as well as tomatoes, good water, and chateaubriand under the Acropolis. Socrates (SV1AE) spent an hour or two at the hotel telling us of the prospects for the civilian SV1s getting back on the air.

I was able to operate a MARS station as SV0WS for a day. This had the usual S-Line, but the 30S-1 linear was not connected. The 30L-1 on 15m had a peculiarity of making a noise in the receiver. It was necessary to switch the filaments on and off for each transmission.

The rotary antenna was a Hy-Gain log periodic, claimed not to have much gain,

Tanzania. . .

Uganda. . .

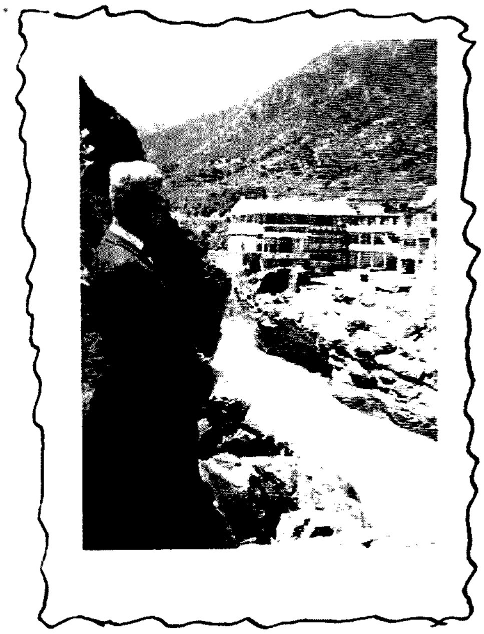
but it had wonderful directivity. Pointed at Europe, nothing but Europeans came through; pointed at Japan, only JAs came through – with a pileup of some 500 stations. Possibly the JAs had been listening to the European calls, and were ready. Upon excusing myself and swinging the antenna, not another JA was heard. A few Ws came through as far west as W7MSF. Most success was on 15m. This operation could have been drawn out into the evening hours, and again the next day – when we went to Delphi to hear what the Oracle had to say about DX. June conditions were not too consistent for the U.S., and anyhow Greece is not very rare. So, we got ready for our Greek Islands cruise.

We made three stops in the first 24 hours: Hydra, an interesting island with a small harbor; Santorini, a large submerged crater with recent activity from a central cone; and Crete. Bill Corbin, now SVØWL in Crete, received a message we sent at the dock, and looked for us at a museum. He and his wife came aboard for cocktails, but time was too short for a visit to the station.

Like in many ships, the scheduled departure of 8 p.m. was anticipated. We were on our way out of the harbor at 7:20!

When we called on the licensing activity in Athens, and met George Chapman of VOA, now SVØWK, the story was that Don Hoff had left Rhodes for home leave. The shortage of calls (one alphabet of 26 calls) led to reassigning SVØWU to Robert C. Smith of the Naval Communication Station near Athens. We wrote to Fred Haney (SVØWQ) about our arrival in Rhodes, which brought a disclaimer from Don who promised to meet us. All equipment had been impounded there when the political unrest came in April, and was still impounded. The civilian SV1s were still off the air in June. The Rhodes gang did not know that the SVØs were permitted to go back on the air in May. My unofficial word was not enough to overrule the instructions to VOA from the Embassy. Office hours are early for the Athens officials; no telephone confirmation was possible that afternoon or evening. The result was a pleasant visit to Rhodes, but the expected

K6KA in . . .



Pakistan. . .

Bangkok. . .

operation had to be omitted to prevent offending someone should I have been incorrect. These political situations are too hot, and violation could be disastrous to amateurs, especially foreign ones, not to take every precaution before operating.

The cruise took us to Efessos in Turkey, near Izmir. It is the site of four cities over thousands of years, and of Paul's epistle to the Ephesians. Then to the island of Mykonos, and back to Athens.

After a happy four days in Vienna, and a flight on Pan-Am over a clear northern Scotland, the Greenland ice cap, the glaciated rock of Labrador, stops in New York, Orlando, and Atlanta, we arrived home. The four cartons of mail, largely 5X5AU/K6KA QSLs, have been taking a bit of time. We missed a bit of DX while away, but saw a lot of it in person. It will be enough to last us a while before we try the leisurely South Pacific trip. Phoenix Islands, anyone?

Sikkim. . .

K6KA in . . .

Santorini. . .

Kenya. . .

Khybur Pass. . .

Persepolis, Iran. . .

Jerusalem. . .

Bali. . .

. . .K6KA■

SPLIT PHONES A DX Operating Aid

A.D. Taylor GW8PG
Greasby,
Cheshire, England

Got two receivers? With a modified pair of phones and a simple switching unit it is possible to have both earpieces connected to receiver 1, one earpiece connected to both receivers, or both earpieces connected to receiver 2. This can be an advantageous listening system.

The System Explained

Putting up a second antenna for receiving is easy, but life becomes difficult when one must juggle two pairs of phones; and two loudspeakers are plain murder! Split phone working eliminates these difficulties. By using a slightly modified pair of phones and a rotary switch both earpieces can be connected to either receiver, or a single earpiece can be connected to each of the receivers at the same time. It is thus possible to monitor two channels at once or one channel on its own merely by flicking the switch.

Typical Examples of its Use

The system has many uses and the three examples which follow illustrate the flexibility which it offers.

Suppose that a ham wants to see what DX is coming through on 20m CW while waiting for the local 75m phone net to open. With split phone working he can have one earpiece connected to his main receiver on 20m and the other connected to the spare receiver tuned to the net frequency. When the NCS calls he can throw the switch and connect both earpieces to the spare receiver, or if a rare DX station comes up in the meantime he can switch both earpieces to the main receiver.

A second example is the common occurrence when it is announced that a station visiting a rare country "will be on either 14.020 or 21.020 MHz, depending upon 'conditions'." With split phone working, both the frequencies can be monitored at the same time. The advantage is even greater if the station uses a transceiver. The receiving can be done on the spare receiver and the transceiver can be left tuned to the calling frequency.

Modifying the Phones

Figure 1A shows a normal series-connected pair of phones. To modify them for split phone working, the connections must be altered to those shown in Fig. 1B.

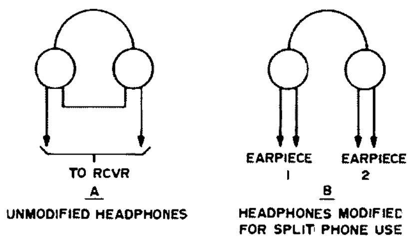


Fig. 1. Unmodified headphones (A) and headphones modified for split phone use (B).

The new phone cord is made from a suitable length of 4-conductor cable which has had 18 inches of its outer cover stripped from one end. The four wires thus uncovered should be split into two pairs and each pair should be twisted together. Each pair is connected to the terminals on one of the earpieces.

The other end of the cable is connected to a four-pin plug. The left earpiece should be connected to the plug so that it connects to receiver 1 as shown in Fig. 2, and the right earpiece connects to receiver 2.

The Switching Panel

Figure 2 shows the circuit of the switching panel. The main component is S1, a 6-pole, 3-position rotary switch. When the switch is in position 1, contacts S1b and S1c connect the two earpieces in series and contacts S1a and S1d connect the phones to receiver 1. At the same time contacts S1e and S1f connect R1 (a load resistor) across the output of receiver 2 to prevent possible damage to its output transformer. When the switch is moved to position 2, contacts S1a and S1b connect earpiece 1 to receiver 1 and contacts S1c and S1d connect earpiece 2 to receiver 2. Contacts S1e and S1f perform no function in this position. In position 3, contacts S1b and S1c again connect the earpieces in series, contacts S1a and S1d connect the phones to receiver 2 and contacts S1e and S1f connect the load resistor across the output of receiver 1.

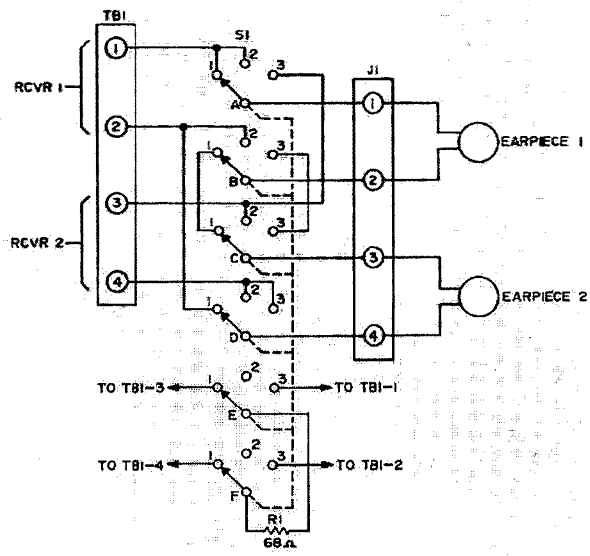


Fig. 2. The circuit of the switching unit. R1 to be a 68Ω, 1W carbon resistor for low impedance output receivers, and a 2.2 kΩ, 1W carbon resistor for high impedance output receivers.

Constructing and Mounting the Switch Panel

This is a simple job. The components can be assembled on a 4 x 5 in. plywood panel or on the lid of a suitable-sized metal utility box. Internal wiring is done with insulated wire and load resistor R1 is soldered directly to the switch tags.

The mounting position of the panel will depend upon station layout. If a control console is used it can be mounted on it.

The Second Receiver

To get the best out of the system, the second receiver should give a reasonable performance. If an old receiver is brought back into service for this purpose, the following hints will help to greatly improve its performance.

Replace all decoupling capacitors in the rf, mixer, and i-f stages with new capacitors of the correct value. This means the plate, screen, and cathode decouplers should be changed. Use new capacitors, not components dug out of the junkbox. Similarly,

change the af interstage coupling capacitors. If the receiver has built-in power pack, replace the smoothing capacitors. Clean up the wavechange switch with switch cleaner, and realign the receiver to the maker's instructions.

To show just what a remarkable effect changing the decoupling and af coupling capacitors in an old receiver can have, I can quote something I did a few months ago. Poking around a local junk shop I came across a 1936 HRO and bought it for $10. When power was connected it worked, but signals were very weak, there was noticeable distortion on the af output, and the crystal gate only acted as an attenuator. Replacing all the decoupling capacitors in the rf, mixer and i-f stages brought S3 signals up to S9, and also brought the crystal gate back into proper operation. Replacing the af coupling capacitors cleared up the audio distortion, and the vintage receiver is now in use as a second receiver, regularly giving good DX contacts. The moral, of course, is that if you shop around and spend an evening working in the shack you can get the second receiver for split phone working without having to hock the XYL's mink!

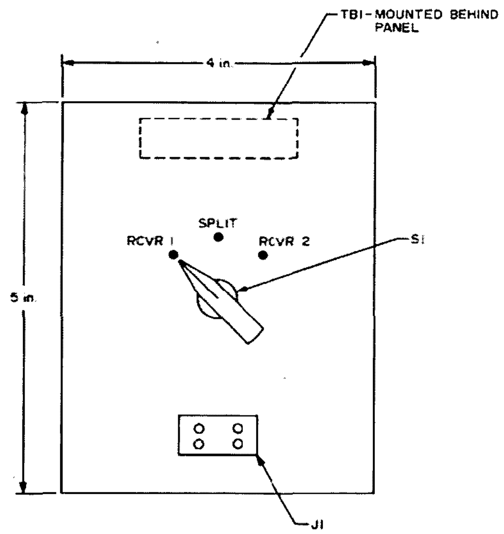


Fig. 3. Layout of the switching unit panel.

. . . GW8PG■

A SPECIAL REPORT

Ham Radio Manufacturing: A STRUGGLE FOR SURVIVAL

Amateur radio has had more than its share of dropouts, as these memorable old photos attest. But things may be different before too long . . . there are subtle but definite signs of an upswing in the offing.

Over the past few years informed marketing specialists and industrial advisors have warned firms against approaching the once-booming amateur radio world with new products. Even the long-time manufacturers of amateur radio gear have

Some of the staidest "old guard" manufacturers in the ham radio field are in trouble, but they're pinning their hopes on a few areas that still show promise.

Ham Dropouts
There was a time when Johnson's Viking units were the most popular items in amateur radio. But Johnson divorced hams when CB came along.

fallen on bad times. The market, they've been saying, is "saturated." All the hordes of hams who were to change from AM to SSB when the technology advanced a few years back have already done so; and the changes since that time have been anything but innovative, thus minimizing the likelihood of any large-scale trade-ups on the part of the amateur fraternity.

Some of the old-timers will look nostalgically at the gear shown here; these are some of the equipment items that at one time were the bulwark of the amateur fraternity. Who didn't know someone who had an Elmac mobile setup, a pair of Gonset "twins," or one of Johnson's Viking units? Now the manufacturers of these fine old standby rigs have gone fishing in better waters.

The saturation problems have been intensified, too, by the relatively static position of the amateur radio service. Where the postwar years saw rapid and extensive growth of ham radio, the past few years have reflected a growth rate of little more than 3%. This meager percentage is actually worse than it looks, too, for it represents an actual per-capita decline in total number of active amateurs; the growth rate in the 16-to-35-years-of-age group (considered the most likely candidate to become hams) has been increasing at a rate considerably in excess of the 3% figure. The last few months tend to show a faint spark of revival, however.

Make no mistake about it, some of the staidest "old guard" manufacturers in the ham radio field are in trouble. National Radio, for example, recently went into receivership as a result of declining military orders and the drought in the amateur field. Hallicrafters expanded into the commercial two-way industry, all but forsaking its once-heavy advertising campaign directed to the ham market. Johnson, one-time ham equipment leader, sought greener grass in CB and industrial two-way fields. Collins, once the "cadillac" manufacturer in the field, hasn't added a new item to its line in more years than it cares to think about. Hammarlund's sales declined to the point where the big-time ham receiver maker could no longer justify advertising in the amateur journals. And names like Gonset, Multi-Elmac, Pierson-Holt, Harvey-Wells, Central Electronics, Waters, and others have either dropped out of the amateur business altogether or have defected to the ranks of CB manufacturers.

There are still manufacturers in the amateur field, but – and this is an understatement – they haven't been getting rich. Companies like Drake, Swan, the ailing National, and Signal One are still in there pitching, but the profits don't come easily, and most of the firms admit that they're barely eking out an existence, trying to tread water until "times get better." And it looks now as if they just might.

The problems faced by ham equipment manufacturers have been compounded recently by the introduction of Japanese imports such as the Yaesu line and Henry's Tempo. Not only do these models meet American quality standards, but they set price standards as well, making it difficult for the U.S. manufacturer to compete successfully while retaining his fair share of the profit dollar. "It's bad enough," says one American manufacturer, "for us to be faced with an already saturated market, but now we have to fight for survival in an area barely able to support us in the best of times." The manufacturer was referring to the fact that, even when ham radio was considered to be "booming," it was still not in the same league with such markets as CB and the hi-fi/stereo industry. And competition from foreign makers makes the prospects for ultimate pullout of the economic slump seem bleak.

The outlook may not be as dismal as it seems at first glance, however. Some recent trends seem particularly encouraging to far-sighted American firms. For example, the U.S. market may have been diminishing or stagnant, but recent indications point to real improvement ahead. And the foreign

market is showing signs of a genuine growth surge. As economic conditions in other nations improve, so do interests in such comparatively leisure hobbies as ham radio. And several American manufacturers are looking to that foreign marketplace as the next major developmental area.

According to a recent article appearing in *Electronic News*, at least three manufacturers were eyeing the foreign market, and the fact that others were making similar overtures was implicit in the article. There is good reason to believe that U.S.

U. S. ham-equipment manufacturers could meet foreign makers head-on in their own territory.

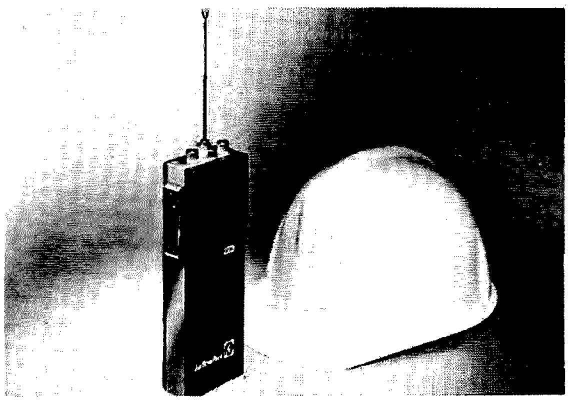
manufacturing techniques, marketing knowhow, and technological developments could meet foreign makers head-on successfully in their own territory – thus giving the competition a taste of their own medicine.

An area that could have a dramatic and forceful influence on the ham radio fraternity is that of the somewhat controversial "hobby" band proposal. This plan, currently being considered by the FCC, would open up a portion of the 220 MHz spectrum to individuals who want to become hams but for one reason or another can't master the traditional code requirement.

Passage of the "hobby" license plan would make hams of thousands of wives who'd like to share the fun of ham radio with their husbands but who just can't spare the time or generate the interest necessary to comply with all the requirements for a General or Technician ticket. It goes almost without saying that initiation of a hobby license would bring new life into amateur radio as well as into the ham radio manufacturing industry.

There are still amateur radio operators who wonder why more ham operators would be desirable. In a 73 "letter to the editor," one ham recently wrote, "Who needs it? The more operators there are, the more interference we must contend with." The amateur lost sight of the fact that

Unable to make a go of it by sticking strictly with the ham radio field, Hallicrafters pushed off into the more lucrative commercial two-way industry. This photo shows Hallicrafters' successful 4W pocket transceiver for commercial service. Marketing men at Hallicrafters are alleged to be considering the prospects of making a version of the unit available to the amateur VHF FM operator.



without a good "market" of hams, there would be no radio equipment industry – and without the industry there would be little if anything to attract new amateurs. And without an influx of amateurs, the ham ranks would wane. Ultimately, other radio services – ever hungry for additional spectrum – would make inroads into those remaining amateur frequencies. The result would surely mean the demise of amateur radio.

It is a fact that the so-called "appliance operator" is the life's blood of ham radio. Questionnaires published and distributed by 73 Magazine showed that more than 97% of all active amateurs are indeed appliance operators – though not exclusively.

In a nutshell, amateur radio needs the equipment manufacturers – but the radio market has shriveled to such an extent that most manufacturers feel something "really big" is needed to properly reinflate it. The hobby band proposal holds a great deal of promise here in the U.S.

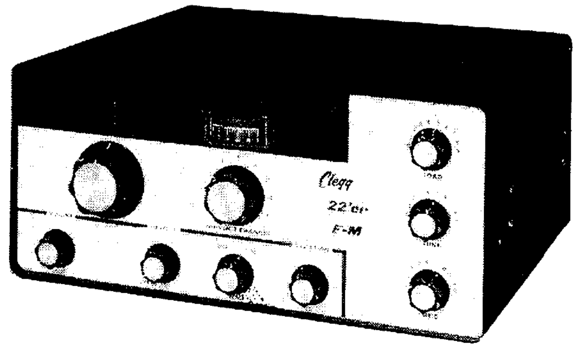
VHF FM is proving to be a vitally need shot in the arm for ham radio.

There are still other signs of salvation here at home, too. One of the most

important elements of amateur growth in recent years has been the advent of the VHF FM repeater. The result of this development has been nothing less than a vital shot in the arm of amateur radio, even though not quite of the magnitude required to sustain the whole industry. American manufacturers, by experience wary of "fads," stood by while Japanese imports snatched a huge chunk of the FM equipment market, which was being shared only with the purveyors of used commercial surplus equipment. But as the surplus market dried up, and the demand for more FM gear continuedd, American manufacturers began responding.

Keenly watching the unprecedented success of Varitronics, Incorporated – which began on a shoestring and is currently the unchallenged leader in the 2 meter FM field – the U.S. industry was determined to gain a foothold. Varitronics offers a line of Japanese imports at prices that are typically American, so the profit margin was wide enough to warrant a few cautious incursions into the apparently lucrative field. Besides, according to some of the recent manufacturing newcomers, there was nothing to lose – because VHF FM is virtually the only aspect of ham radio that is exhibiting any growth at all.

The first of the American firms to try for the FM market was International Communications and Electronics Company, a small Texas corporation. But ICE dropped out of the running within a few months due to design problems, inadequate ser-



One of the newer entries in the 2 meter FM field is the 22'er by Clegg. This unit uses vacuum tubes in the final to produce more power output than is available on most transistor types. With a tunable receiver calibrated to match existing FM channels, the 22'er marks a departure from crystal control. To preclude the possibility of losing sales because of the lack of fixed-channel control, Clegg is also reportedly about to produce a fully synthesized receiver, which allows the operator to "dial" any FM channel between 146.04 and 146.6.94, retaining the desirable characteristics of crystal control without sacrificing the stability and repeatability normally lost with continuous tuning.

An act that's hard to follow. The Varitronics import, Model IC-2F, is a compact unit that combines transistors and ICs, packs a 10W punch, and includes circuit that shuts down rf output when the vswr on the antenna gets uncomfortably high.

vicing facilities, and premature release of production models that had not been debugged fully. But the imports kept coming and were being accepted by anxious amateurs hungry to get going in this rapidly expanding field. Varitronics retained its lead, though other distributors made attempts to challenge the leader with Japanese imports of varying degrees of quality and price.

In the face of ICE's disaster and the phenomenal success of Varitronics' import line, another American firm made its debut against bets within the industry that this new upstart, World Radio Labs, would be heading for an early failure. Bu the line – Galaxy – made it. Finally an American made unit was successfully selling against the hot Varitronics line, and even though it couldn't match the Varitronics unit in performance, it sold at a price well below that of the import.

The eyebrows of other American manufacturers were raised as Galaxy continued its erosion into the market that most experts said was spoiled by "low-priced used gear and Jap imports." And before long other U.S. makers jumped in, each with improvements and innovations that

Telecomm, a California company, imports the 10W unit shown here, but stocks the integral modules as well. The module boards include the receiver, transmitter, and power amplifer.

commanded the attention of the VHF FM enthusiast.

First there was Regency, with plenty of channels, lots of power, and virtually no "frills or fancy stuff." The Regency unit was priced plainly to grab Galaxy's increasing share of the market – it bore a modest retail tag of $229 and set new standards of performance within the American radio manufacturing industry. Then Clegg, who was determined to market a transceiver that provided all the advantages of crystal control for the transmitter, but the flexibility of tunable control for the receiver, introducted its unit – with a whole new set of standards. It had a tunable receiver that was as hot as a stovetop and a transmitter that combined tubes and transistors to pump out more power than any of the competition.

The most recent entry, Drake's "Marker," is a hybrid of sorts. It is a Japanese import, but it is being marketed by an American manufacturer as a compromise between Japanese production capability and American expertise in peripheral servicing and marketing.

In spite of the growing involvement of American makers in the traditionally Japanese-dominated field, the inward flow of the import continues, each unit touting new concepts or features. Telecomm, for example, imports not only a conventional 2 meter FM transceiver but a complete line of receiver, transmitter, and power amplifier circuit-board "modules" as well.

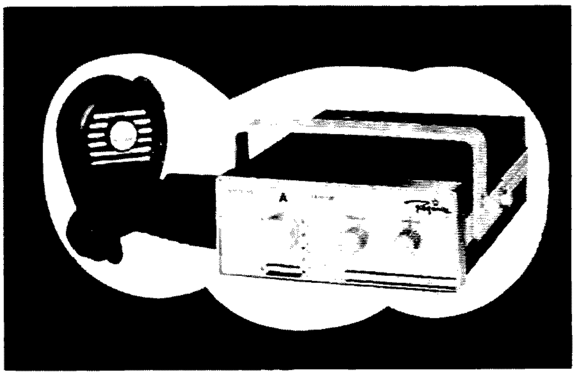
And the market shows no signs of losing any activity in the near future either, even though it should get progressively more

Even those manufacturers who became disenchanted with the ham market are taking a second look.

difficult to show a profit in view of the increasing competition. Each month, several more firms announce new VHF FM gear to be made available. And even those manufacturers who looked once at the market and turned away are reportedly making a more thorough reexamination of it now. In this latter category are companies like Heath, Hallicrafters, Swan, and even Johnson. The going won't be easy for any of them, though. Yaesu is on its way with a 2 meter FM transeiver, for example, and so is Trio. And the Standard import, at one time strictly "marine," turned to the ham market and is reportedly making headway with its own expanding line. So the competition will get tougher and tougher, even though most of the manufacturers can hardly keep their delivery apace with new-unit orders.

The impact of all this in-fighting could have a dramatic and beneficial influence to the ham in terms of total value per dollar of investment. But most important of all is the fact that this flurry of activity on our VHF bands has already begun to draw more people into the ranks of ham radio. And many of the inactive oldtimers have already come out of hiding to join the swelling ranks of the FM'ers.

It is quite likely that the growth of amateurs in the VHF ranks can more than



This tiny 10W transceiver is Regency's bid for a share of the low-budget 2 meter FM transceiver market. It has a 12-channel capability and no frills. Sales price: $229.

accommodate the growing list of VHF FM manufacturers. The plain fact is that at no time in the history of ham radio has this current expansion of FM interest been paralleled. Even the development of sideband in the late fifties and early sixties was incomparable in terms of adding new faces

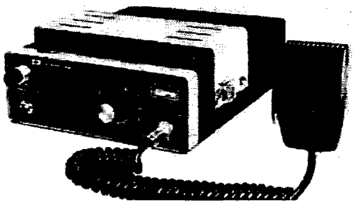
VHF FM population is pushing 30,000, and there's no indication of any letup.

to the existing ranks. And there appears to be no end in sight!

In 1969, during the heyday of FM Journal, there were an estimated 10,000 active FM'ers. Today, there are easily more than 2-1/2 times that number, and an estimated additional thousand operators appear each month. The repeater directory published by 73 Magazine (April 1970) listed some 250 active open repeaters and made reference to a large number of additional closed repeaters. An updated directory currently being prepared for the April 1971 issue of 73 already lists more than 500 repeaters, and this figure is expected to increase by no less than 25% before the publication deadline.

Also, despite the increase in the total number of open repeaters, owners of the "standby" repeaters listed in the previous directory tend to report a substantial increase in the number of user stations. These factors, and others, point to a VHF FM population that is very closely approaching the 30,000 mark – which surpasses the total circulation of two of 73's competitors!

To the great relief of manufacturers and dealers in the ham radio field, the current VHF FM boom has had little if any negative effect on the conventional amateur market. Indications are that a number of the new FM'ers are indeed from the dyed-in-the-wool low-band SSB crowd, but there is no indication that the newcoming FM'ers are deserting their old modes. Wayne Green, publisher of 73 Magazine, says he makes it a point to delve into the question at conventions, club meetings, and at every opportunity. "It appears," he said, "that VHF FM is more or less universally taken up by the sidebander as a supplement to his hobby rather than as a replacement. Amateurs who operated on other bands before trying 2 meter FM continue to operate on the other bands. They use FM as something of an intercom among themselves to keep each other apprised of DX conditions such as rare station appearances and band openings, to maintain car-to-car communications at transmitter hunts, to pass traffic, or to participate in public service functions."

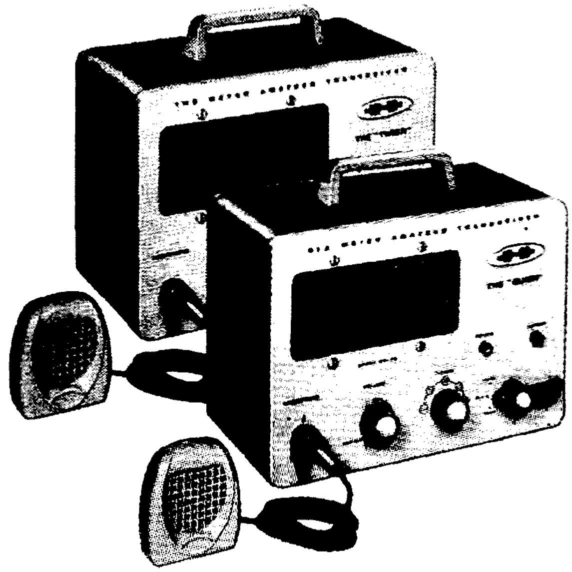


Drake's "Marker Luxury" transceiver is the latest entry into the booming 2m FM field. Selling for about $330, the unit comes with 12-channel capability (two sets of crystals supplied). Conservatively rated at 10W out, the transmitter section uses transistors for all stages except final amplifier.

At this stage of the nation's economy no one will deny the very considerable medicinal effect FM has had on ham radio. As Herbert W. Gordon, a well known New England amateur radio dealer puts it, "I wonder how many of us would be able to keep afloat if it weren't for the tremendous amount of activity in VHF FM. Equipment sales in this area are leading all other amateur sales by an unbelievable margin."

Smooth sailing for the amateur radio equipment business appears now to be right around the corner. Foreign sales holds promise for many manufacturers. The FM field is attracting more every month. The amateur ranks are at long last projected to be on the upswing. There are signs that the economy of the country will be pulling out of the downward spiral. There is good evidence pointing to a favorable reaction of a hobby license for the 220 band. And semiconductor advances seem to indicate a new generation of low-cost components in the future. All these factors weigh heavily in favor of our equipment manufacturers, who have weathered the worst storm in the history of amateur radio.

HEATH TENER MODIFICATION



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Much has been written about Murphy's Law and other such disaster syndromes, but it has only been a matter of recent time that I have dared to admit the existence of the excruciating Ellers Effect.

The "effect" in action would have me put a Heath Tener in the car, start off for some mobiling, but promptly blow the 1.5A fuse because I had forgotten to install the heavier 8A protection required for the dc supply.

Conversely, and with greater risk, having installed the 8A fuse, I would then use the Tener on the ac supply. The oversize fuse protection threatens total wipeout.

As the expression goes: "I may be crazy, but I am not stupid." After several decades of living with the Ellers Effect (EE) I have learned to at least try to outfoil my own forgetfulness. So I modified the Tener – a 10-minute project any Tener owner can and should accomplish.

I cut holes in the rear chassis and case and installed a second fuseholder. I then rewired the power input circuits (see diagram) and also the output of the dc supply. I used decals to identify the fuseholders. Now both fuses are in place at all times, and the proper fuse is automatically selected when either power supply is connected.

Another Tener modification (a matter of convenience not involving the EE) was the drilling of holes, in the cabinet top, large enough to pass tuning wands down to the rf coil slugs.

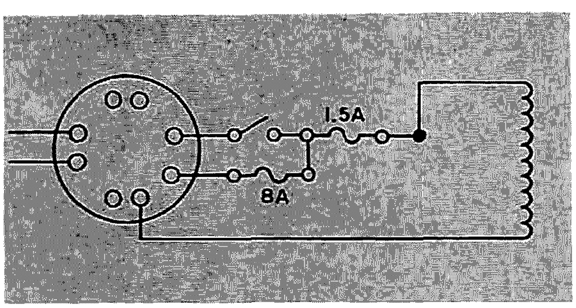


Fig. 1. Modified input wiring.

This eliminates having to remove the Tener from the case to peak these coils for different antenna arrangements.

Careful layout of these holes will mean you can drop the wand straight down onto the slug screws. But even so, you can peek through the vent grill enough to get the wand where it belongs.

Dick Ellers K8JLK ■

TESTING THE RP ELECTRONICS COMPRESSOR

When the pile starts building up on a rare one you need that extra oomph to get a word or two in edgewise. Once you have your kilowatt and your three-element beam, like the others in the pile, what can you do to get that edge? It will not come as any big news that the next step is either an illegal attic antenna matching unit (with power supply) or a compressor.

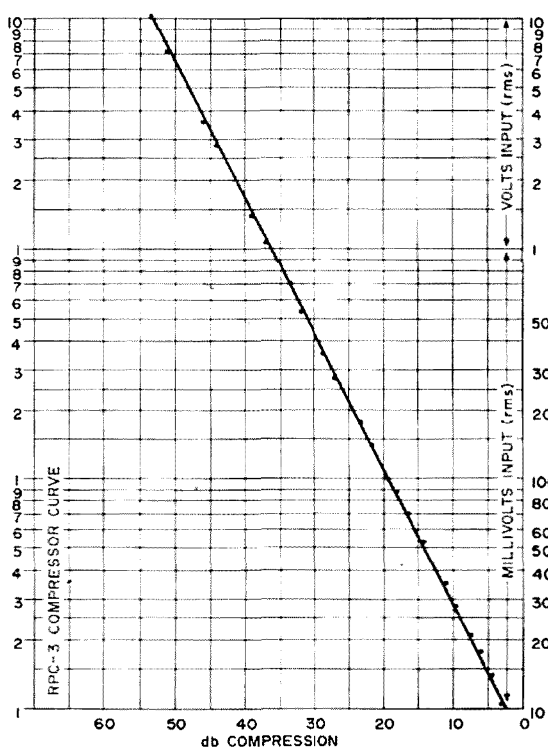
Do compressors work? Of course they do! If they didn't you wouldn't see quite so many on the market. Like everything else available to us, some work better than others. The RP compressor is recommended highly in the ads so it was decided to test one at the 73 HQ station to see if the on-the-air reports were as enthusiastic as the advertising manager of RP.

In answer to a request to test, in came a little box. The RPC-3C measures 4 x 4 x 4 in. and has one in-out switch on the front panel plus a screwdriver pot adjustment for level. One might wish for knobs to twiddle, but they are unnecessary and probably would only permit things to get out of whack. There are two jacks in the back, one marked in, the other unmarked, obviously "out".

The installation of the unit takes several hundred microseconds, while you plug your mike into the RPC-3C and run a patch cord to the mike input on the rig. Flip the switch to "in" and jump into the nearest pileup.

What reports did we get using the compressor? On the average one S-unit improvement was reported consistently by operators in all parts of the world. And what about distortion? This is the problem with most compressors, so particular reports were requested on speech quality. The unit does change the sound of the voice, but no distortion was noticed or reported. Mostly it gives the voice a lot more punch.

Many articles have been written on the basics of compressors and why they give this boost to output power. Nutshelled,

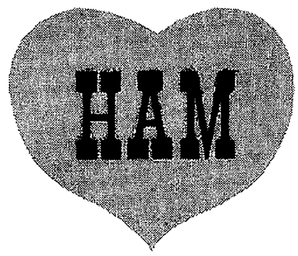


they raise the average voice level by compressing the peaks by as much as 30 dB and leaving the valleys alone. This permits a higher gain without distortion. It does not sound like hi-fi, but it sure punches through when there is interference or the signal is down in the noise.

RP has units that sell from around $20 to $35, depending on the model.

. . .Staff■

for the love of a



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If a wife wants to share her husband's interests and be able to talk intelligently to him about his work, she must put forth her best efforts to learn all she possibly can about the things that interest him most in life.

A simple fact? Well, maybe for some wives who are married to doctors, attorneys, etc. BUT – what do you do when your husband owns and operates an industrial 2-way radio service and his hobby is "hamsville"? Ugh! I can't think of a thing that would be less interesting for a woman than learning the Morse code, much less about the electronics involved in 2-way radios. Double ugh!

But, my self-claim to reasonable smarts and my strong desire to please my choice of mates had forced me into the woes of applying for a ham license. After all, how much could there possibly be to learning how to push a button on a mike and saying, "Fine business, OM. . ." Oh me, oh my! I had a lot to learn and then some.

I mentioned my eagerness about becoming a ham one evening to my spouse, Fred, and he grinned from ear to ear. Fortunately, we have a friend who has the class of license one needs to enable him to give and supervise someone taking the FCC exams. One phone call is all it took to get myself into the worse mess I have ever lived through in my life!

The very next evening, our friend, whom we shall call Don, appeared on our doorstep with an armload of books, paper, pencils, and application for my exam.

My first instructions were to the effect that although Don is a personal friend, if and when I took my exam, I would be strictly on my own – no cheating and no help during the test. Of course, I resented being told such a petty thing since I have NEVER cheated on a test in my life! Well, maybe just a little, but never anything really important like getting my very own ham license.

The first thing I had to do, of course, was learn the code. The initial few dits and dahs were no problem at all; in fact, some of them were rather cute. We worked on the simple ones first, like o, e, i, s, and d. Groovy! No problem. Nothing to it! All was just great. If there weren't so many dahs in the middle of dits and dits in the middle of dahs, I could have stayed out of trouble. But as it was, I was becoming confused and couldn't seem to keep things in their proper order. In the first place, a dit had always been a dot and a dah had always been a dash to me. And then came the big announcement – I had to learn the entire alphabet, numbers from 0 to 9, punctuation marks, and be able to send and receive five-letter words at the rate of five per minute!

"Forget it! I quit!" was my reaction. "I'll never be a ham." That ended my first lesson and as far as I was concerned, my last.

For three days I was teased, pestered, threatened, dared and double-dared by friend and hubby. I had chanced a few peeks at the code and before our next session with the books, I had managed to learn a few dahs and dits all by myself. Don would like to think that he alone was responsible for my code learning, but I put in many hours on my own to get it mentally entrenched.

Finally, I was ready for my code test. Don would send and I would receive. All went well. My turn to send and Don was on the receiving end. I made up a sentence and wrote it down first. It was hopeless! Don couldn't keep up with me! I guess it

was a bad case of nerves on my part because slowing down didn't affect my needed speed at all. Figuring that I had already conquered the hardest part of the test, I was eager to get started on the next phase.

I must hand it to all the male hams everywhere who have ever had to teach a female the basic fundamentals of electronics. I became bewildered, confused, argumentive, bored, tired, and completely unreasonable during the weeks of study that followed. I could see no reason why I had to learn so much. For one thing, I never intended to build my own radio; all I wanted to do is push a button and keep track of my old man. I continuously rebelled and refused to accept a simple answer for anything. I begged Don to put it all on a tape recorder so I could plug it into my ear while I was asleep. I bought a book on self-hypnotism and another on self-mental-magnetism, but nothing seemed to work. By then, I was a desperate woman.

Don had given me a deadline and it was only a week away. I was on my own, and any last-minute cramming had to be done with no help from anyone. I calmly assured myself that I would never pass the test. I was convinced that hams must be the smartest people in the world. For the first time in my life, I felt like a housewife instead of my usual self-appointed title of household engineer.

When D-day came, I woke up with a headache. Every conceivable inconvenience plagued my entire day, with a few acts of stupidity thrown in for excitement. I brought in the mail, took meat out of the freezer for supper and spent the next two hours looking for the mail again. I had put the mail into the freezer and the hamburger on my husband's desk. I was so nervous that I forgot to have a cigarette until late afternoon.

Don was invited for supper and I decided to let the men fix their own hamburgers. In my state of mind, charburgers would have been the order of the day. A plate was put before me and I couldn't eat a bite. I had to wait until everyone finished eating before starting on the test. I think Don and Fred really enjoyed watching me squirm. They seemed to take hours eating their one lousy sandwich.

It has always been my practice to complete a test or exam as fast as possible, checking questions I'm not sure about as I go along to answer after the completion of the easier ones. It took about 45 minutes to run through and answer the questions that I knew without hesitation, another 45 minutes on the tricky ones and I was done. Don looked briefly over my test, kept a straight face and didn't say a word. The rat.

Without saying yay or nay, he mailed my test back to the FCC. I'm usually a patient person but waiting drives me up a tree. After two months, I was convinced that either (1) I must have failed or would have heard something before then, (2) the FCC decided not to issue licenses to females this year, or (3) my perfectly adorable mailman enjoyed my daily rush to the mailbox so much that he had decided to tease me a little bit.

I calmly broke my neck trying to catch the mailman on May 10, 1970, three months after my exam, to find a letter in a plain white envelope addressed to me with the call letters WB6AOF following my name. The return address was from Providence, R. I., one S. S. Dana WN1MYB, whom I had never heard of before. I learned that Dana had received his ticket and as a bonus, they sent him a spare – mine. I was elated, to say the least. I had what is commonly referred to as a typical woman's reaction – I sat down and bawled.

Now I am the recipient of literally tons of "ham mail" and I love it. I was immediately urged to join the ARRL (American Radio Relay League) and I irritate my husband monthly by stealing his copy of 73. And to top it all off, in January I can go to SAROC in Las Vegas and be officially registered to win the grand prize in the drawings.

I'll go, but I have a hunch that if I win anything, there'll be some ham in Tinyville, Maine who'll tell me the news, maybe a year or two after the drawing.

. . . WB6AOF ■

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DUTY CYCLE DUTY FACTOR

Duty cycle, duty factor, what's it all about anyway? Before the war this expression was seldom heard. With the advent of radar, the expression entered our technical vocabulary. More recently, with the widespread acceptance of single sideband, the term has become part of amateur jargon.

Briefly, duty factor can be explained as "how long you hold the key down." If a ham operator were to tie the key down, and then run the output from his rig into a dummy load, the key-down time would be 100%, and likewise the duty factor.

The nearest ham equivalent to 100% duty factor is in the operation of radioteletype equipment, using frequency-shift keying. The key-down time in this mode of operation is in the neighborhood of 98%, which closely approximates our reference figure of 100%.

With hand-keyed CW emissions, the amateur may expect a duty factor of approximately 48%. This is not a hard and fast percentage, since human characteristics such as the individual "fist" enter into the picture. Commercial stations which utilize automatic keyers generally allow for 46% duty factor. This is based upon certain norms, one of which allows that the word *Paris* is typical of run-of-the-mill commercial radio telegraph traffic. This convention also allows for the general acceptance that one dot space (called one "baud" by the commercials) is okay for a dot, and three bauds constitute one dash. There are allowed for automatic transmission one baud between parts of a letter, three bauds between letters, and five bauds between words. It adds up to about 46%, but most amateurs when using CW can assume 50% "duty factor" and come reasonably close.

Single sideband, suppressed carrier transmissions are generally conceded to put the lightest load of all upon the system and its power supply. Again there are no infallible rules, due to individual speech patterns, but it is generally agreed that SSB transmission may load down the equipment as little as 27%. However, a duty factor of 40% would realistically reflect typical amateur operating conditions. If some form of speech compression or limiting is used, the talk power will be increased, and the duty factor would increase a bit.

When the RTTY, CW, or SSB operator switches from send to receive, the only power consumed is the bleeder current. This current may be bled off through a fixed resistor, or the final amplifier tubes may be biased to perform this function.

Both the power supply and rf section must be taken into consideration when duty factor is being figured. With respect to receiving tubes being used for service, the ham designer may figure roughly "plus 50%" when going from consumer sweep-tube ratings to amateur ICAS ratings.

. . .W2OLU ■

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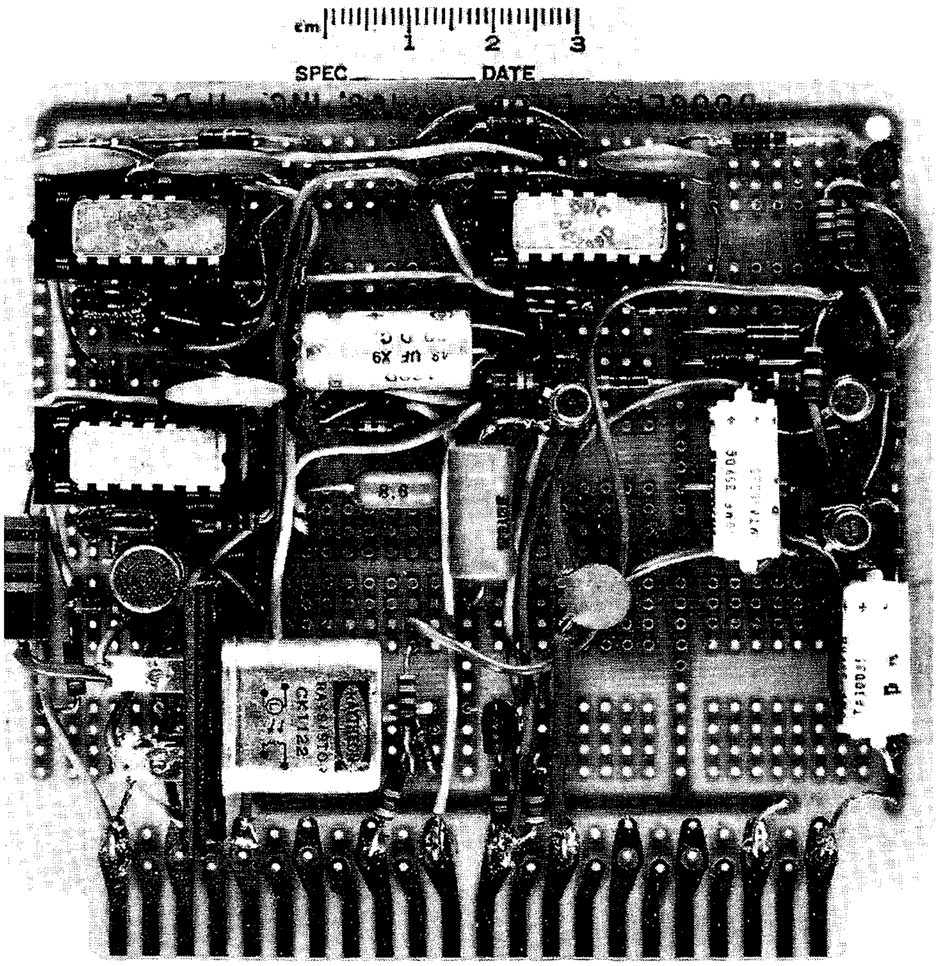

REPEATER ZERO BEATER

One of the biggest problems with an FM repeater is getting everyone's transmitters exactly on frequency. It is even more important with a narrowband input; yet, since most hams do not have ready access to a frequency meter or counter, it is rather difficult to do. This article describes a device that uses the repeater's receiver as a reference and makes it both convenient and easy for everyone to get on frequency. It is as accessible as the repeater, and in effect, is the same as having someone always monitoring the repeater receiver's discriminator voltage and giving back the reading after each transmission (but without the basic personnel problem). Since it is always there, it allows anybody using the repeater to see how well his rig is staying on frequency.

The device is called a zero beater because it produces an audio tone which behaves in exactly the same way as a heterodyne (although it is not). The zero beater operates by monitoring the repeater receiver's discriminator voltage during a transmission and storing a representative voltage in a capacitor. When the transmission is completed, this voltage is converted to a tone, which is transmitted during the repeater's tail period (approx. 1 second). All it takes then, is two seconds to check frequency; a one-second transmission to

establish the frequency, and one second to listen to the tone. If the frequency is less than 1 kHz off, no tone will be heard. Each time the repeater is keyed, the process repeats, up to 15 seconds of repeater use. Then the zero beater is disabled until the repeater is idle for 15 seconds or more. (The disabling feature was added after the zero beater was installed because the squeaks and squawks tend to become objectionable with excessive use.)

Operation

The zero beater is built on a 4 in. square plug-in board and requires ±15V for operation. Referring to Fig.1, which is a schematic of the completed device, the receiver's discriminator voltage is applied through a resistance of 100 kΩ to the noninverting input of opamp A1. The operation of A1 is bipolar so that the polarity of the output voltage will swing positive or negative to follow the polarity of the input voltage. The output of A1 is applied simultaneously to the inverting input of A2 and to D2. The output of A2 is applied to D1. When the output voltage of A1 is positive, D2 conducts and the output voltage is applied across C2 (when Q3 is normally cut off).

When the output of A1 is negative, D2 is back-biased and therefore disconnected, while the output of inverter A2 now swings positive, forward-biasing Dl, and voltage appears across C2. Because of the operation of D1 and D2, the voltage appearing across C2 is always positive regardless of the input polarity.

The output of A3 drives Q1, which in turn drives a CK1122 "Raysistor." The Raysistor consists of a tungsten filament lamp and a cadmium-sulphide photoresistor in the same package, with the lamp illuminating the photoresistor. The 8.6V zener (D3) across C2 prevents the voltage across the lamp from becoming too high. The photoresistor portion of the Raysistor is used as a frequency determining component in a unijunction oscillator circuit (Q2).

The dark resistance of the photoresistor is high enough to prevent Q2 from oscillating. As its resistance decreases, the frequency of Q2 increases up to about 2 kHz. While a signal is being received, the frequency error seen at the discriminator is stored by C2 and, through A3 and Q1, illuminates the Raysistor lamp. At the same time, the positive voltage (A) applied

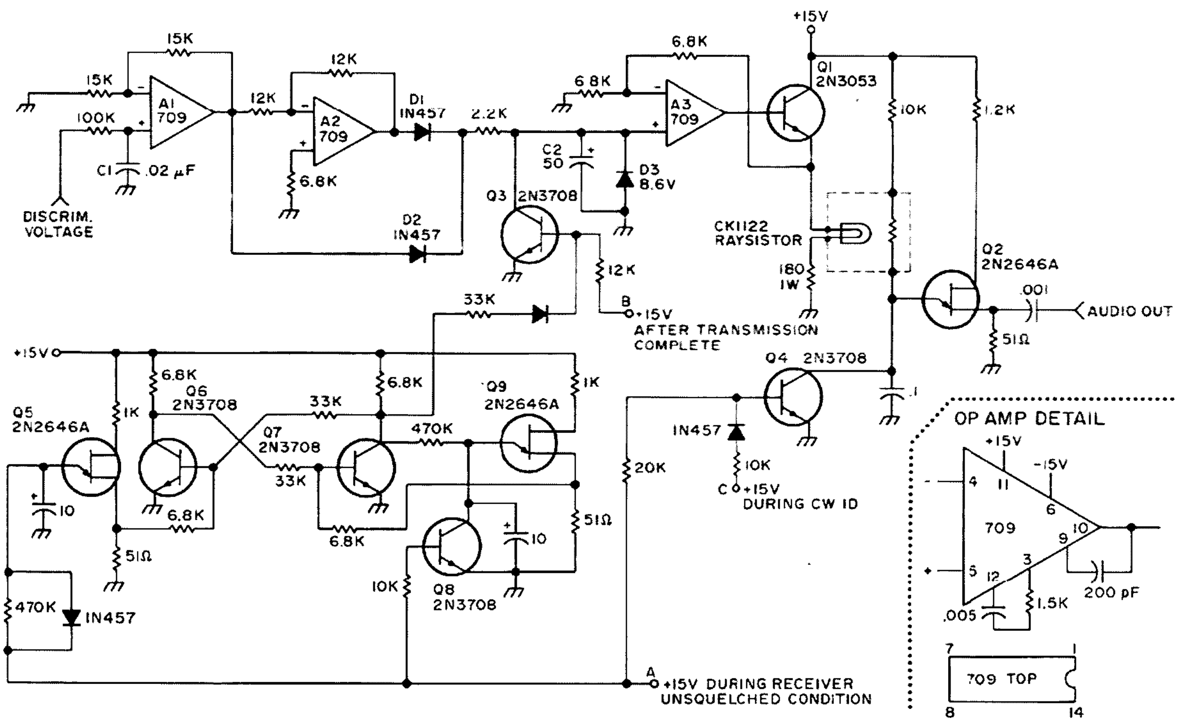

Fig. 1. Off-frequency tone generator.

to the base of Q4 causes it to conduct, shorting the emitter of unijunction Q2 to ground and preventing it from oscillating. As soon as the receiver no longer hears a signal, Q4 shuts off and allows Q2 to oscillate. During the repeater tail period, then, the tone is transmitted back. As soon as the repeater transmitter is unkeyed, a positive voltage (B) applied to Q3 causes it to conduct, discharging C2. C2 must be discharged in this way because of the high input resistance of A3.

The remaining circuitry comprising Q5 through Q9 is a "timeout" control circuit which disables the zero beater after 15 seconds of repeater use and reenables it after the repeater has been idle for 15 seconds or more. Q6 and Q7 form a flip-flop which is set or reset by Q5 and Q9. Both Q5 and Q9 are 15-second timer circuits.

Steering control for the flip-flop is accomplished by Q8, which shorts out the timing capacitor of Q9 when the repeater is in use. After the repeater has been in use for 15 seconds or more, Q5 completes its timing cycle and discharges the 10 μF timing capacitor into Q6, setting the flip-flop. Then the collector of Q7 goes positive, and the positive voltage coupled to the base of Q3 causes it to conduct, shorting the input of A3 to ground and disabling the zero beater.

When the repeater is inactive, point A goes to ground, Q8 is turned off, unshorting Q9's timing capacitor, and Q9 begins its timing cycle. After 15 seconds, Q9 discharges into Q7, resetting the flip-flop and enabling the zero beater.

External Connections

As shown in Fig. 1, the external connections required are power, discriminator voltage, audio output, and three control voltages. The control voltages are connected to points A, B, and C on the schematic, with the conditions shown. The inactive state of all three signals is ground. In the WA1KFY repeater, the CW identification function is self-completing; in other words, the repeater stays on until the ident has completed. It is necessary to inhibit the zero beat during the ID; otherwise both will play at once. This repeater uses solid-state logic for its control functions; however, the required signals (A, B, and C) may be derived from the COR of a relay-controlled repeater.

Summary

The zero beater provides everyone using the repeater with a continued frequency check. It has proved to be a very effective and useful device. The tone reaches its highest frequency when the input error is approximately 3 kHz or greater. If the error is less than 1 kHz, no output is generated. Since the device uses the receiver's discriminator output, it is important that the repeater receiver's frequency be accurate and stable.

Other uses for the device readily suggest themselves; for example, limiter voltage could be monitored, and the tone would then indicate signal strength. It could also be used as an alarm. In either case, A2 could be eliminated along with D1 and D2, since the input polarity would not change.

. . . W1ELU & W1IRH■

Getting HEP To ICs

73 will be presenting a series of simple IC projects. This initial article serves as the introduction by describing the "basics" of IC convention and nomenclature.

Integrated circuits are here to stay and the next few years will show a massive transition in industry and consumer products to complete integration. Based on this assumption, this article has been prepared for the amateur as well as professional user of integrated circuits (ICs). It includes tips on wiring, soldering, cross referencing, and simple projects using the ICs contained in the Motorola HEP kits.

A lengthy discussion of IC construction will not be covered in detail, as this information can be found in many IC textbooks. However, in order to be better able to know the advantages and limitations of those microcircuits, the reader should know what is contained in the basic IC and how these devices differ from other solid-state components.

As the name implies, an integrated circuit is a collection of many different components. The quantity and types of components vary from one IC configuration to another. A particular IC could contain active components (transistors, diodes) and passive components (resistors, capacitors). If all the components of the circuit are contained on the same "chip" or substrate, the unit is said to be "monolithic" (single crystal). The monolithic type is the most common and the least expensive to build. Other construction types are: thin film, thick film, hybrid, multichip. A discussion of these types can be found in almost any book that deals with the subject of ICs.

As an illustration of the extreme size reduction possible with integrated circuits, consider the Motorola 4-bit memory core, which contains 524 different components on a chip 50 x 70 mils. The average IC is much smaller, usually 40 mils square (1 mil = .001 in.). As the above example indicates, the race is on to see how much circuitry can be crowded into the smallest space. This effort is known in the trade as LSI (large-scale integration). Manufacturers are already starting to produce ICs that contain FET tunnel diodes, and even power transistors!

It is unfortunate, but many people are resisting the changeover from discrete (individual) components to ICs. This resistance could largely be due to the fact that people tend to shy away from circuits they are not familiar with.

The advantages of ICs over discrete components greatly outweigh the disadvantages. Size and weight reduction are obvious advantages but cost savings should also be considered. Consider the HEP 583, which contains 21 transistors and 27 resistors. If you had to buy all these parts individually and build this unit using a breadboard or printed circuit board you would indeed feel the pinch on both your pocketbook and your time. Other disadvantages that are not so obvious are as follows:

Repetition

If you need a circuit containing 20 J-K flip-flops, it would be a difficult task to build 20 of these, each containing 21 transistors and 27 resistors. This adds up to 420 transistors and 540 resistors! With ICs, only 20 TO-5 packages are necessary. Here is where cost, size, and time advantages come through again.

Repeatability

Because of the way ICs are constructed with components located in close proximity to each other, tolerances are much finer and parts are better matched, thus making up a device that functions as a complete unit. Power drain is lowered, there is less spurious noise pickup, and there is less noise generated within the unit.

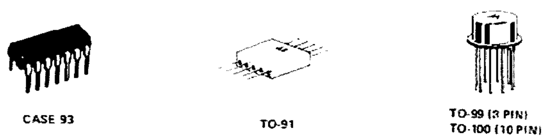

Fig. 1. Typical IC case styles.

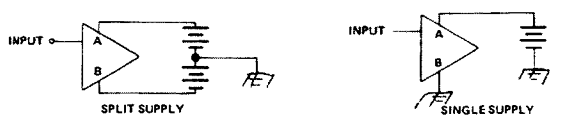

Fig. 2. The split supply contain four series batteries grounded at the connect point. Where possible to use, the single supply offers the advantage of simplicity.

Reliability

Many manufacturers are turning to ICs because of their high reliability. Devices built under almost clinical conditions are bound to be better than a circuit built on a workbench. As an example, consider building the electricaequivalent to the HEP 583, using the 21 transistors and 27 resistors: It would be necessary to make 80 to 90 solder connections, a real source for potential trouble.

In addition to the advantages listed, replacement is simple. Schematics are easy to read, especially for the beginner. Areas yet to be conquered in the construction of ICs are: How to built inductors, large-value capacitors, and high-value resistance on an IC chip. It is presently necessary to connect these components externally.

ICs can be mounted on perforated board or printed-circuit board by either soldering to terminals or using sockets. Sockets are definitely recommended, especially for the hobbyist who will, generally, use the IC over and over in different applications. Constant soldering and unsoldering of the leads weakens them and could cause the wires to be broken, or internal damage could result due to excessive heat from the solder iron.

The HEP 580 thru 583 (devices included a Motorola IC kit) are mW RTLs. This logic family is considered the easiest for the hobbyist, experimenter, and IC novice to "cut their teeth" on. The HEP 584, 570, 571, 572 are MRTLs – also a good family for the beginner. The HEP 553, 554, 556, 558 are ECLs – not the easier to work with, but the best logic family for high frequency and noise rejection.

IC Packaging

Integrated circuits can be found in a variety of packages. At the present time, there are more than 120 case types made by some 70 companies around the world. Of these many case styles, three types are dominant. (In terms of quantity of devices on the market, in a given case type, about 90% of their quantity can be found in some variation of one of these three case types). As yet, no definite standardization has been set up among the manufacturers regarding packaging, pin numbers, and locations, so carefully check the basing before you plug that IC into the socket. Three popular case styles are pictures in Fig. 1.

Use a low-wattage soldering iron! 25 to 40 watts is a good range. Excess heat could "kill" the IC.

Keep component leads short! Excess lead length could cause spurious or parasitic oscillations or no operation at all.

If you are using a power supply (other than a battery), it is a good idea to bypass the power leads. Connect a 0.05 or 0.1 capacitor from the power input to ground at or near the input terminal of the IC.

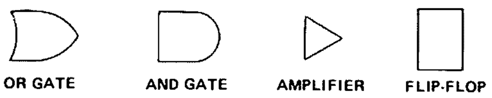

Fig. 3. Four basic logic element configurations used in IC diagrams.

Power Supplies

j For projects using 1 or 2 ICs, batteries are usually the best supply. On larger projects, an ac supply is better. The power supply requirements for the various logic functions have been standardized as follows:

RTL	3AV ± 10% (2.6 to 3.3V) and 3.6 ± 10% (3.24 to 3.96V)
MwRTL	3V ± 10% (2.6 to 3.3V) and 3.6 ± 10% (3.24 to 3.96V)
DTL	4V ± 10% (3.6 to 4.4V)
MDTL	5V ± 10% (4.5 - 5.5V)
VTL	±4V to ±10V (8 - 20V)
ECL	5.2V ± 10% (4.5 - 5.5V)
TTL	5V ± 10% (4.5 - 5.5V)
HTL	18V

Obviously, batteries in some of these odd voltage ranges are not available: however, experimentation has categories as follows: many of the devices were found to work well from 1.5 to 12 V! *Very few* did not – but after all, they are only rated from 2.6 to 4V (approximately). This makes it possible to use many of these ICs over a wide voltage range. Usually an IC rated at 3.2V minimum works well on 3V and one rated at 5.5V maximum works at 6V.

ICs can be connected in one of two ways, using one or two supplies. The dual or split supply is most common in linear circuits. The two supplies are shown in F:g. 2.

There are some applications where the split supply is advantageous but generally it involves more complicated circuitry. The novice in ICs is likely to be a novice in the area of computer logic also. The logic symbols are to digital ICs what schematic symbols are to resistors, capacitors, etc. Some of the more common types are shown in Feb. 3. These symbols have recently been standardized by the government. Before that time, each manufacturer had his own set of symbols.

Basic Logic Types

Most computers work on the binary principle. Binary stands for "two",– two states or conditions, which are either *on* or *off*, *high* or *low* or *1* and *0*.) Consider the condition where we have zero or near zero volts at the input to a gate, flip-flop, amplifier, etc; with positive logic it is an *off* condition. If this voltage goes positive, let's say to 1 or 2V, it is now in an *on* condition.

The common functions in digital ICs are:

- Gates - control the passage of signals.
- Buffer - amplifies power of signals to be able to drive more units.
- Inverter –, reverses the logic from + to - or - to +.
- Expander – affords additional inputs to a gate.

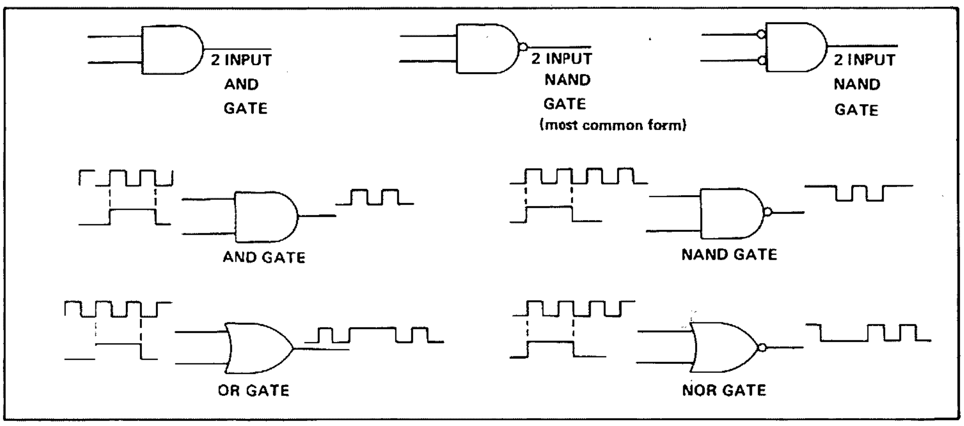

Fig. 4. Basic gates with their input/output waveforms.

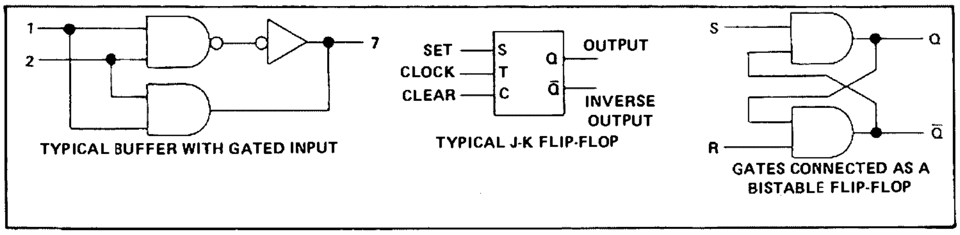

Fig. 5. Basic amplifier and flip-flop configurations.

- Adder – provides the *summ* and *carry* operations on two input signals.
- Shift Registers – provides bistable storage.
- Flip-flop - provides division or *count.* One flip-flop divides by 2, provides one output change in state for every two input charges.

Gates. This function comes in a wide variety of configurations. There are 2, 3, 4, or more inputs and 4 categories as follows:

- *And:* When all inputs go to 1, output will go to 1.
- *Nand:* Output will be 1 except when all inputs go to 1.
- *Or:* When any input goes to 1, output will be 1.
- *Nor:* Output will be 1 except when any input goes to 1.

Nand and *nor* differ from *and* and *or* in that inversion has taken place. Refer to Fig. 4. Note the small o at the input or output of some of the examples. This o indicates that inversion has taken place.

Gates can be connected to operate in a wide variety of applications other than those for which they were designed. Some applications are free-running multivibrators, bistable, one-shot, amplifiers, and audio mixers.

Occasionally the time arises when the hobbyist needs something in the way of gates other than what he has or what is available. For example, you need a 3-input gate and you have a 4-input gate; simply ground one input. Ground two inputs to obtain a 2-input gate. If you have a dual 2-input gate, such as the HEP 580, and you need a 4-input gate, tie pins 6 and 7 together and this becomes the output; inputs are then on pins 1, 2, 3, and 5.

Amplifiers. In digital work it is referred to as a buffer. Its original use is to increase "fan-in" or "fan-out" capability; that is, the number of other units that can be connected in parallel to the input (fan-in) or output (fan-out). By adding proper external biasing it is possible to connect this unit to linear (audio-rf) usage.

Flip-Flop. There are a number of types of flip-flops available. As mentioned previously, a flip-flop (multivibrator) can be "made up" by cross connecting two gates. The R-S flip-flop is one example. The J-K flip-flop is similar but has the added function known as "clock input" shown as "T" on the logic block of Fig. 5.

Fundamentally, flip-flops divide by two. By proper connection, division by 3, 4, 5, etc. can be obtained using a few ICs as shown in Fig. 6.

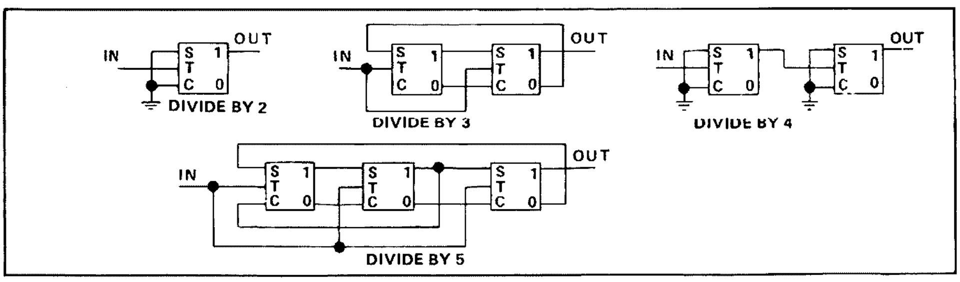

Fig. 6. Flip-flops connected as dividers.

Voices from the PAST ...

50 YEARS AGO
AMATEUR RADIO

Amateur radio operators virtually beat the sun across the continent during the recent daylight tests when a message starting promptly at dawn on the East coast, reached Los Angeles, Cal., before the sun appeared above the Pacific horizon. Favorable transmitting conditions were met which made the trans-continental trip possible in one hour and twenty-five minutes with but two relays.

An early start clinched the laurels for D. McR. Parsley, operator of amateur station 4FT at Wilmington, N. C. It left Wilmington at 6:15 A.M., Eastern Standard Time, and reached Los Angeles at 4:40 A.M., Pacific Standard Time. The message read: "Are you all set for the Transpacific tests? Answer at once." After being relayed by amateur stations 5PB and 6AWT, it was received by B. Sano, of 855 S. Birch Street, Los Angeles

Ten messages were started from either coast and according to the incomplete logs that have arrived at the League headquarters, many of these dropped by the wayside on account of the necessity for constant relaying under unfavorable daylight conditions. Several hundred amateurs participated in the tests. One message starting from the East coast read: "A drop of the Atlantic ocean goes with this message; return with the salt of the Pacific."

Salinas, California, is reported by W6CLV to be an isolated 112–224 megacycle area. On his monthly trek to S.F., he found that W6PIO Alameda, W6TFZ PNQ San Francisco and W6PYH Oakland are new – at least to him.

W6QLZ says that his 2½ meter signals seem to have less fading than 5 (but are received on a converter with superregen detector at OVK so there is some a.v.c. action present). Clyde is trying to get W3HJQ/6 up before daylight for dx schedules because signals are good then even when they are only 50 percent in the evening. This phenomenon is familiar to many who have had experience with low atmosphere bending.

30 YEARS AGO
RADIO

At luncheon in April, W4EDD made the observation that during his travels he has found that the majority of hams interested in 112 megacycles are relatively new at it – for which reason the majority of articles about 2½ meter equipment should be elementary "how to build it" stories about relatively inexpensive equipment. How about grinding out a few, fellows, to help out the newcomers?

10 YEARS AGO
73 Amateur Radio

The production of a new and strange kind of variable capacitor recently came to the attention of the writer. This capacitor takes the form of a semiconductor, is about the size of a germanium diode, and is available in sizes from 7 to 100 mmfd. The strange thing about this little gadget is that the capacity is a function of a dc bias voltage impressed across it. The manufacturer, Pacific Semiconductors Inc., Culver City, California, use a standard voltage of four volts as the 100% capacity rating point. It may be seen from the curve in Fig. 1 that at zero voltage the capacity is about 250% and at 100 volts the capacity has dropped to 20% of the 4 volt value. *Caution:* A reverse polarity voltage should never be used and any superimposed ac peak must not go on the other side of zero.

As soon as you get the full import of the above you begin to get ideas. The "Varicap," for such is its trade name, has many possibilities. The first one the writer thought of was an FM modulator.

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BASICS of SURPLUS FM

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Electrically, the FM base station is exactly the same as a mobile, except for the power supply. Usually, the transmitter and receiver "strips" are absolutely identical in the mobile and base version of the same series.

Physically, the base station can come in many forms. First of all, the common desk model is quite popular. This may be the best version for the ham because some desk models have an external mike gain control, modulation meter, and built-in clock. Rigs such as the trunk mounted mobile may have only a volume, squelch, on-off and channel switch.

You can either have the controls right on the unit itself or have a remote control head at the operating desk. Still another type of base station is the type mounted in the weather-proof housing. This is really nothing but an outdoor relay-rack type panel. At some sites, the whole station is located a couple of hundred feet up the tower in this type of housing. This is ideal for the remote transmitter-receiver or repeater type setup. (I'd like to see someone do this with their KWM-2).

Since base stations are more scarce than mobiles, you can figure on paying about 25% more than the identical mobile for your base. It's a simple case of product in demand.

Since FM operates on fixed channels, being on frequency is especially important. Crystal controlled receiving, as well as transmitting equipment, is the key to this reliability.

Let's now say that we have a crystal controlled transmitter and receiver. Good... now we have half the battle licked. As you may or may not know, the frequency at which the crystal operates depends on the load capacitance of the input of the oscillator. When ordering crystals, be sure to get one which is designed especially for your oscillator's capacitance. If the capacitances are not matched, you will be off frequency. There is a good side to this story, however. In just about all commercial FM rigs, you will find a small ceramic trimmer either in parallel or series with the crystal. This "rubbering" capacitor is used to get you *exactly* on frequency. To tune the transmitter to the frequency, you need a receiving station with a 50-0-50 μa meter plugged into the discriminator jack. If you know that the receiving station is on frequency, simply turn the "rubbering" capacitor until the receiving station indicates that his meter

reads zero. You do this while transmitting with no modulation. For tuning an off frequency receiver with an on frequency transmitter, the procedure is the same, but you read the receiver's meter while turning the receiver's capacitor.

Crystal ovens are often used on FM. The purpose of an oven is to keep the crystal at a constant temperature to keep it always on frequency. With an oven, even on the coldest mornings, you will be exactly on frequency within a matter of minutes. These ovens have a single temperature between 60^{o} and 85^{o}C in which the crystal is placed. The ovens usually come in either one or two crystal models. When using ovens, be sure that the crystal is designed for that temperature. Used ovens run between $1.00 and $3.50, but sometimes surplus rigs come with them.

You must use very high quality crystals. Don't even consider using surplus. The prices usually run between $4 and $7 for a .0025% crystal. These crystals are also made to order. When ordering, specify holder type, load capacity, oven temperature (if used), crystal frequency and formula as well as operating frequency, afc or non-afc circuit, and radio model number. In any event, you can never include too much information.

When changing frequencies with these commercial rigs it is not just a simple case of having all the crystals go to one rotary switch and then to the oscillator. Since being on frequency is of the utmost importance, a separate oscillator and "rubbering" capacitor is provided for *each* crystal. Many rigs use just one half of a 12AT7, for example, for one frequency, then switch cathode circuits to use the other half for the other frequency. However, with most rigs the most frequencies you can normally have is two frequencies transmit and two frequencies receive. To go through a repeater, you will normally need one frequency for receiving and two frequencies for transmitting. In some areas, however, the repeater output is not located on the main channel and you may need two frequencies for receiving also.

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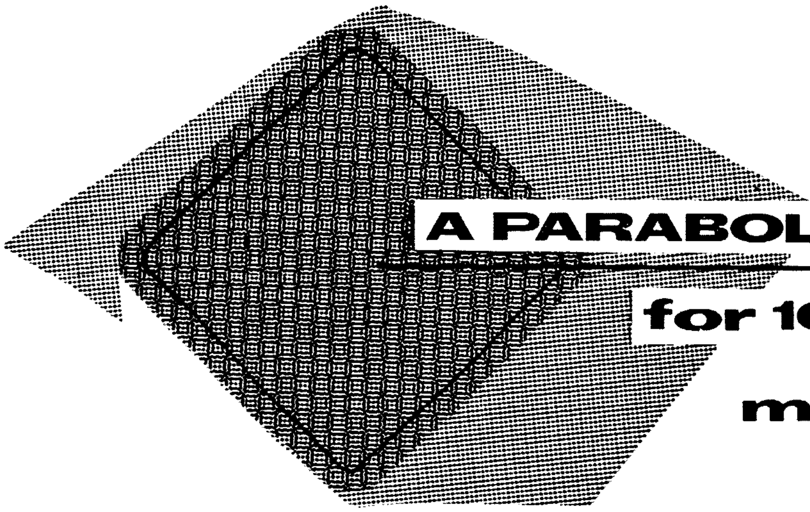

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A PARABOLIC BEAM for 10, 15, 20 meters

If you are looking for high performance in a beam antenna at a reasonable price, this parabolic beam antenna for 10, 15, or 20 meters might be the answer. It works on the same principle as the corner reflector antenna. Figure 1 shows a 1 in. aluminum tubing configuration shaped like part of a circle. The aluminum tubing is 20 ft long before being shaped as shown in Fig. 1. The aluminum tubing is bent so that 100 degrees appears between points A, B, and C.

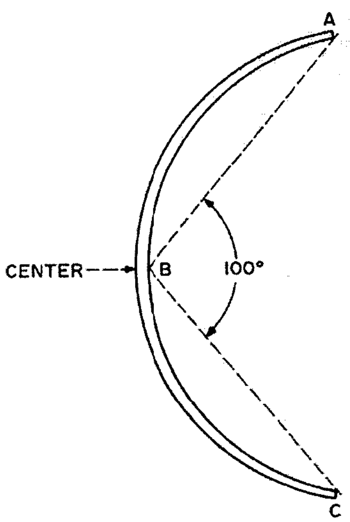

Fig. 1. The curve should be kept uniform.

Figure 2 shows another piece of alumi num tubing bolted at right angles to the original tubing (ABC). This additional tubing is identical to that shown in Fig. 1 and is shown as a straight line (DBE). The aluminum shown in DBE in Fig. 2 is actually bent into the same configuration as tubing ABC of Fig. 1. Bare copper wire is used to strengthen the elements ABC and DBE as shown in Fig. 2. Also, this wire is needed to support the aluminum sheet metal shown in Fig. 3.

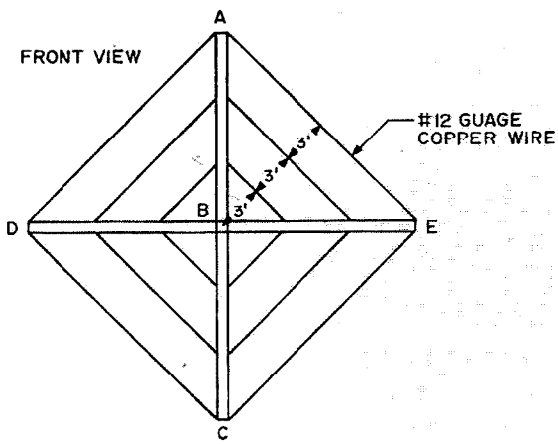

Fig. 2. Copper wire forms the basic framework.

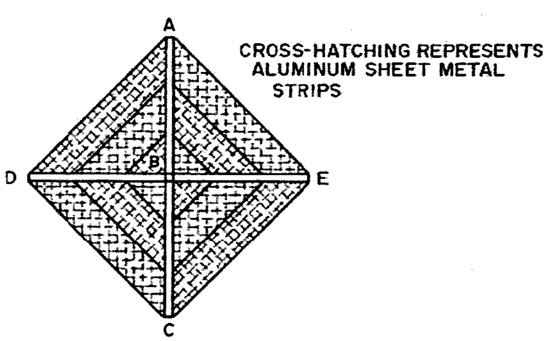

Fig. 3. With the addition of shaped sheets of aluminum, the dish begins to look like an antenna.

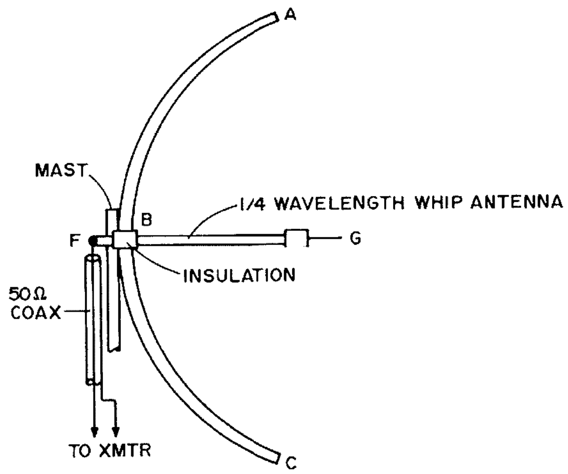

Fig. 4. The driven element can be any good-quality quarter-wave whip. Keep the whip insulated from the reflector and feed it with 50Ω line.

The sheet metal shown in Fig. 3 is approximately 0.04 in. thick. You will need a roll about 80 ft long. This will act as a giant reflector element giving the antenna a 40 dB front-to-back ratio.

Figure 4 shows the driven element FG. This may be any good quality vertical antenna such as the hustler series by Newtronics. It must be resonant on 10, 15, or 20 meters. (Aluminum rod DBE of Figs. 2 and 3 is not shown in Fig. 4.) The driven element (FG) must be insulated from the rest of the antenna system. This may be done with plastic sheets and tape. The driven element (FG) should be kept at least ¼ in. away from the rest of the system at point B of Fig. 4. The antenna is fed with standard 52Ω coax cable. The feedpoint (F) should be bolted and taped carefully. The shield of the coax should be connected to a nonrotating portion of the reflecting segment of the antenna system. Forward gain will vary anywhere from 14 to 25 dB depending on the type of driven element used and the frequency band it is used on. Generally, the higher frequency bands (10 and 15 meters) will deliver improved performance. The dimensions given for the reflecting portion of the antenna may be the same for each band.

Good DX results have been obtained with this antenna with low power and a tower only 20 ft high.

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The Galaxy FM 210

If you ever had any doubts that FM as a mode for amateur operation was here to stay, you may quietly put that doubt to rest forever. A quick glance at the advertisements and articles in the amateur magazines should show you the impact that VHF FM operation is having on ham radio today. There are many concerns that are selling used police and taxi two-way gear and a number of small and large equipment manufacturers that are making gear strictly for amateur use. Until recently the only ready-made gear available for VHF FM operation was the stuff manufactured by the commercial and public safety two-way radio companies: Motorola, GE, RCA, Kaar, and a dozen or more others. Bargains were and still are commonplace in second-hand gear that has been retired from commercial service. But much of this gear is ten years or more old, designed with vacuum tubes, powered by dynamotors, and strictly for mobile use. Some conversion is necessary for amateur use, depending on what frequency you are going to use and whether or not you plan to use it in your car.

Now, however, there are a number of completely transistorized units on the market, *designed solely for amateur use,* fully wired and ready to plug in and operate. Generally, these units have been of Japanese manufacture, designed for FM operation on 2 meters, running somewhere between 1 and 10 watts output. Most cost $250 or more, but are selling quite well nonetheless. *Galaxy Electronics* has not only come out with a 2 meter FM transceiver that has features similar to the Japanese-made units on the market, but has incorporated the best feature of all, as far as Japanese electronic equipment is concerned: low price. *Galaxy* has beaten

the transistor technology of Tokyo at its own game by undercutting the price of even the *least* expensive Japanese rig by $50. And mind you, the FM-210 is all-American, parts and labor.

The FM-210 has a trim and deceptively simple look to it. It almost looks more like a control head than a complete transceiver. On the front panel there are concentric controls for off-on-volume and squelch, receive channel, and transmit channel. Also there is a pilot lamp and mike jack for PTT hi-Z mike. To open up the unit, all you have to do is remove four sheet-metal screws on the bottom of the case and slide the entire chassis out of the cabinet. The cabinet, incidentally, is very rugged, being made of very heavy gage metal.

Inside, you find four printed circuit boards and some chassis-mounted wiring. One board is the front end and first mixer, another the i-f section and detector, a little one in the back is receiver audio, and the last board contains transmitter audio, oscillator–doubler, doubler, and the varicap modulator. Another doubler, the driver, and power amplifier are mounted on the chassis proper. Mounted on the back wall is a heavy duty T/R relay, antenna connector, and power plug.

The final transistor, by the way, has a separate power lead for its collector supply running to the power plug. That's so you can run 28V on the final collector for extra power. In fact, that's what is done in the AC-210 power supply for fixed station (or mobile) use. The AC-210 is available as an accessory for $40. The transceiver requires 14–16V dc for power, but works nicely on a 12V storage battery. If you plan to use the FM-210 primarily for fixed use, you could build your own ac supply, or better yet, get an old storage battery to power the rig. That way, you still have a rig on the air during a power failure. For mobile use, however, that 16V rating is very comforting, especially if you're not sure exactly how much voltage is coming out of your car's generator or alternator.

Receiver Section

The receiver section starts with a 2N5485 FET rf amplifier feeding another 2N5485 operating as the first mixer. A third and fourth 2N5485 serve as oscillator and tripler to drive the mixer. A third and fourth 2N5485 serve as oscillator and tripler to drive the mixer. From the mixer the incoming signal is fed to a 2N3855 i-f amplifier operating at 10.7 MHz. Then, the signal is heterodyned by a 2N3855 mixer down to 450 kHz. A 2N2926 is the crystal-controlled second oscillator. The signal is now fed into a 4-pole filter which is adjusted at the factory for optimum FM reception. The filter is used to provide the selectivity necessary to eliminate adjacent-channel QRM. After filtering, the signal is fed to a pair of 2N2926s, which provide the needed i-f gain to drive the limiters. Yes, there are TWO limiters!

Following the limiters is a novel fixed-tuned discriminator built around a Clevite ceramic resonant component. The detected audio is fed through two stages of amplification provided by another pair of 2N2926s and then to a 2N3638 audio driver and a D42C1-D43C1 matched "complementary pair" transistor output stage, which drives the built-in speaker.

According to the manufacturer, the receiver sensitivity is rated as 0.5 μV for 12 dB SINAD and 1.0 μV will give 20 dB quieting. At my QTH, with a homebrew groundplane about 25 feet in the air, I heard a mobile station in New York City, about 35 miles away. His signal was noisy, but Q5 nonetheless. And this was a "direct" signal – no repeater. Speaking of repeaters, I've been able to key up two different repeaters from my fixed location, and one of them from the car. All this with full-quieting signals at the repeater's receiver. Not bad for only a few watts, eh?

Transmitter Section

The transmitter section begins with a two-stage audio amplifier (a pair of 2N2926s) driving a 2N4916 clipper. There are controls on the printed circuit board for clipping depth (mike gain) and modulation deviation (clipper output level). Following the clipper, the audio is processed by an active filter. A 2N2926Y and a 2N4916 serve in the active filter

section. Modulation of the transmitter is accomplished by an MV1628 varicap in series with the transmitter's crystal.

A single 2N3563 serves as the transmitter oscillator and first doubler, followed by a 2N3904 second doubler, 2N442 third doubler, 2N4427 driver, and a 2N5641 power amplifier. The final is rated for 10W output at frequencies up to 500 MHz, so you are not pushing it at all when you run the FM-210 on 12V. According to the instruction manual, the transmitter is tuned up for operation, with the crystals supplied, into a 50Ω resistive load. That means that you shouldn't have to touch anything inside the transmitter if you use a groundplane or coaxial type antenna and stay within a half megahertz or so from 146.94. The transmitter is fairly broadbanded: I can switch between 146.34 and 146.94 with no appreciable change in output.

Channel Selection

Channel selection for the three possible receive and three possible transmit frequencies is accomplished by two front-panel switches. Notice that there are two selectors: one for transmit, one for receive. This is a very flexible arrangement since it enables you to choose any combination of receive and transmit frequencies for which you have crystals. The FM operator will quite often transmit on a different frequency from the one on which he is receiving. This is the procedure when using an FM repeater, for example. For those times when your friendly local repeater is out of service, all you have to do is switch your transmit frequency to the repeater output channel and you are all set to operate "simplex." At this point, however, you will appreciate the value of a repeater, unless your QTH happens to be on top of a mountain. For strictly local contacts it's a good idea to operate simplex anyway, so that you won't tie up the repeater when you don't really need it. The extra receive frequencies are especially useful if you plan to operate mobile and do a lot of traveling to different cities; not all repeaters are set up to transmit on 146.94 – some are on 146.88 or 146.76. It all depends on what the local clubs have decided should be the proper channel for their particular area. And, too, some areas have several repeaters in service.

The FM-210 comes with crystals for transmitting and receiving on 146.94 MHz., the nationwide standard FM channel, so you should be able to talk to someone as soon as you wire up the power connector and hook the rig up to an antenna. However, I'm sure you will want to avail yourself of your local repeater, so find out what the input and output frequencies are and order the proper crystals.

The entire transceiver is very well constructed, and it is obvious that a good deal of thought has gone into the design of the rig, especially when you inspect the insides and look over the schematic. If your local dealer will let you, open it up and take a look at the guts of the thing! American-made components of good quality are used throughout and all rf transistors (except the final) are mounted in *sockets,* just in case you do something nasty to this fine little rig. Make sure, though, that all transistors are firmly seated in their respective sockets. They could loosen up in shipment or during excessively bumpy mobile operation. Layout of components is neat and very accessible, should service ever be needed.

The FM-210 is a fine little rig – at home both in the car and in the shack. Its only real limitation is its low power: over a long haul, you'll have a rough time of it. Most of the boys with commercial gear are running at least 30W or more. And that's 30W output. But for local QSOs and contacts through a repeater, the FM-210 can't be beat.

One final note: each of the dozen or so hams to whom I have shown the intruction manual for the FM-210 has been very impressed with the quality of the book: it is easy to read, indexed, spiral bound to lie flat, and tells everything you need to know – even where to order crystals. And the schematic is very large. It's a foldout about three feet long, clearly drawn, and easy to read. You have to see it to appreciate it.

. . .K2ULR ■

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LIGHTNING As It Affects Ham Radio

Back during the war, when the inventive German mind was finding front line uses for amplifiers in telephony work, with two wires inserted into the earth some 200 feet apart, an enemy operator listened to Allied telephone messages by amplifying the small induced currents in the earth picked up by the wires. No record exists of how effective the means of spying turned out to be except that the operator heard curious whistles and wanted to know where they came from. The whistle was found to be caused by the lightning in a storm, or lightning not necessarily associated with a storm. This led to the discovery that at any instant there are about 1800 lightning storms on the globe.

We live in an area where the frequency of lightning storms is very great compared to the "average" location. Some 90 of the 360 days per year may find thunderstorms in the area.

What, then should we do? Let's turn to the insurance companies and the electrical code to find some answers and back to Benjamin Franklin to find others. If you research any particular project you will find that the basic physics and chemistry were well known a hundred years ago but the hardware may not have been readily available to the average person at that time.

In 1752 printer B. Franklin wrote many letters in regard to the properties of lightning, and the greater share of the buildings in Philadelphia were protected by the rod he "invented" and improved. There was some discussion in the scientific circles of the day regarding the use of a point on the rod versus a simple overhead protective wire such as the power companies use today. One school of thought held that the pointed rod would actually cause lightning strokes more often than the spherical terminal would, yet the spherical would offer the same protection in case of a stroke.

The power companies have found that if ground wires are kept above the "hot" lines, there is a protective factor involved. As a proof that this is not always effective, GE puts out a gadget we should all have on the service entrance to the house. It is a lightning arrestor costing about $8, available from the local electric supply house. It is intended to prevent a stroke which hits the lines and causes a "bump" in voltage to pass down the lines from entering your home. This protects all the equipment you have plugged into the outlets and also the lighting you have in the home.

First, let's talk about the destructive effects of lightning. If it strikes a tree, the current through the tree may cause the temperature of the sap to go to 27,000 degrees. This, of course, destroys the tree because the steam cannot escape fast enough to the atmosphere – so it "blows" the tree, or maybe just the bark. The same happens in a building where the reinforcing rods do not have electrical connection; the

lightning jumps the gap and causes steam to be emitted which causes great damage to the particular portion that gets hot.

There is another peculiarity we should be cognizant of: If you have a rubber-covered 14-gage wire on the antenna lead-in, the copper may be completely disintegrated, and the rubber not destroyed. This has been observed and also investigated in the laboratory. Knowlton, writing in the Handbook for Electrical Engineers, says high current peaks may shatter trees without setting fire to them, while a succession of the current peaks may well cause a fire. High-current short-time discharges passed through a 14-gage rubber-covered wire can eliminate the wire but leave the rubber apparently undamaged. Hollow or flat conductors may be crushed by high lightning currents owing to both heating and magnetic effects.

Other authors speak of the magnetic effects and the distortion to the point of disintegrating circular conductors such as pipes. Again to Knowlton – the largest conductor known to have completely burned through by a stroke is a 4-gage solid copper conductor. He is speaking of the ground wire over a power line used to intercept the stroke and to conduct its current to ground without sufficient potential developing to cause a flashover between the ground wire or tower and the conductors.

The Britannica offers several interesting comments:

1. Experiments on power lines at high altitudes suggest that if we were at an altitude of 18,000 to 20,000 ft, we would not have any strokes of lightning taking place. The 100 kV line from Denver to Argentine pass (1 mile to 13,500 ft) was found to have much less lightning stroke current as altitude increased.
2. Strokes seen but not heard: With an upward initial leader stroke, not followed by downward leader current peaks, the rate of rise and decay of current may be slow enough so that the sound of thunder is not heard. On this basis thunderless strokes would only occur on high buildings.
3. Persons struck by lightning have been revived by artificial respiration. The result of being struck is electric shock and burns, or both.
4. Trailing antennas from planes is likely to increase the possibility of a stroke, and antennas pulled by planes are sometimes destroyed by lightning.

Suppose you have a tower on the top of your home and you want to protect yourself. What now?

Using the above references and others, the following list was compiled.

1. Place a GE protector on the incoming power line at the service entrance. Cost is $8.
2. Find two points in which to connect the down wires to ground, such as a metal waterpipe. Dig up these two locations and determine that the pipe is metal and in suitable condition to connect the wires to them. They should be on opposite sides or ends of the home. If pipe is not available, ground rods must be driven. These should be 5/8 in. copper-coated.
3. Use 4-gage stranded copper wire for the down wires. Cost is about $20 per 100 feet.
4. The best installation will have at least two down conductors and they will be at opposite ends of the building to be protected. This provides an overhead wire that will umbrella the whole house.
5. String the down wire along the house and bring it down so that the current will take the most direct path to ground possible (no short bends). Bond each end to the pipe or the rods with clamps in a location so that they may be checked occasionally to see that they are sound mechanically. The wire is stranded for two reasons: First, the stroke is fast enough so that we may consider it a stroke of 25 kHz or greater frequency. Remember, the more surfaces, the greater the current-handling capability. Therefore, the current tends to travel in the outer part of the conductor. Second, the stranded wire is more resistant to accidental cutting.

6. Go back and bond to the antenna and then look around to see which of the projections above the house are of metal and are within 6 ft of the ground wire. These might be vent pipes or chimneys, etc. Connection from the ground wire to these metal pipes is necessary so that there will be no current jumping the gap. Remember that it is the current jumping that creates an arc and therefore heats and causes fires. A bond wire prevents this from happening.

7. The books suggest you run the down wire outside the home. I ran mine inside on the basis that the wire can be made more direct to the ground connection and the conductivity of the copper is better than that of any other material the lightning will pass in its travels. Some books agree with this. It is also a means of reducing corrosion, making the installation more pleasing to the eye, and reducing the possibility of someone cutting it down as an act of vandalism. The disadvantages are that the wire is hard to string through the narrow openings, and the bonding must include the ductwork in the attic.

8. If air terminals are used, they should be high enough to prevent danger of fire from the arc.

9. A cloud passing over the area will cause an area of several miles to be charged as it moves. This means an electric current in the ground. As it passes over your area, the wires will also be charged. For this reason it is best not to leave the antenna hanging loose. Ground the lead wires, or install an arrester.

10. Remember that connections can be batteries and will cause corrosion if made of dissimilar metals. Use only accepted connectors and cable clamps. They will be clearly marked Cu or Cu/Al if both metals. Make all materials mechanically secure to prevent loss of protection.

. . . Patzsch ■

IC RECEIVER ACCESSORY

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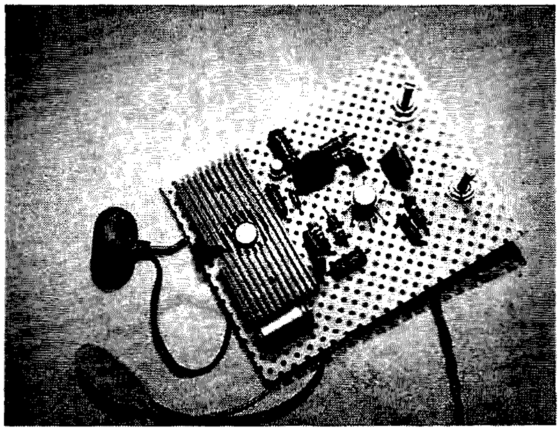
Readily available Motorola HEP units are featured in this compact accessory unit, although other ICs may also be used. The unit is designed to plug into the headphone jack of any receiver (or transceiver) and provide tunable af selectivity, agc and sufficient audio power for direct loudspeaker operation.

Audio frequency integrated circuits provide the opportunity to develop very useful circuit functions—in many instances at a far lower cost than would be possible using discrete components. On the other hand, the inherent nature of the IC housing and the conditions under which it must operate also make the practical realization of a circuit using IC's, in some instances, just as complicated as a circuit using discrete components. This seeming contradiction was experienced by the author in developing the receiver

Power amplifier IC mounted in heat sink is shown on left. FET and associated components are at upper right side of heat sink. Other components are conveniently arranged around dual stage FET. Potentiometers shown on right are miniature type mounted directly on perforated board stock.



accessory unit described in this article. So, even if one has no immediate need to build the unit described, it may prove interesting to still read about and appreciate some of the considerations involved in the use of audio integrated circuits.

General

The accessory unit described was designed as a compact, solid-state unit that could be plugged into a medium to high impedance headphone jack and function as a self-contained unit to provide tunable af selectivity, agc and about 1 watt of power for direct loudspeaker operation. By the addition of a few diodes a simple noise limiter can also be added. For compactness and simplicity, only a resistor-capacitor network was used without any inductive elements to obtain audio selectivity. The resultant selectivity is not as sharp as that provided by a bulky inductor but is quite usable on CW, especially with a transceiver that already contains a steep-skirted crystal or mechanical SSB filter. The fact that the af selectivity is tunable also adds to its usefulness. The agc feature is not absolutely necessary but was added since many transceivers, although their avc cannot be disabled as such, do not provide full agc on CW when the rf gain control is at some intermediate setting, as would be normal if one were using the rf gain on CW as the "volume" control while tuning. The audio output amplifier was included to eliminate the need for going back into the receiver in order to use its audio output stage. Thus, no modification whatever is required to the receiver and the accessory unit can simply be unplugged from the headphone jack when it is not desired for operation.

Circuit

A block diagram of the accessory unit is shown in Fig. 1. The basic stage functions are relatively simple. The incoming audio is split into two parts, each going ½ of the HEP592 (a hobbyist version of the MC1535 dual operational amplifier sold as a stereo preamplifier). One section of the HEP592 serves as a level detector with an adjustable threshold. When the positive going portion of the input signal exceeds the threshold level, an output voltage is produced which when rectified is coupled to the gate of a HEP801 FET. The drain-source resistance of the FET is normally quite low but increases to several thousand ohms with increasing negative gate-source potential. This wide resistance variation is used to regulate the gain of the power amplifier IC. This "forward" method of obtaining agc is somewhat different from the usual "backward" method where part of the final output af voltage is rectified and then used to control the gain of a preceeding stage. However, it works just as well and with some experimentation of the circuit time constants, it may even appeal to some as providing more responsive agc action than the "backward" system.

The other section of the HEP592 serves as a tunable af filter. Advantage is taken in constructing the filter circuit of the fact that most "operational amplifier-turned-hobbyist" IC's provide a differential input. That is, so-called inverting (-) and non-inverting (+) inputs. A portion of the input signal is fed to the non-inverting input. The other input is coupled to the output via a tunable audio filter which passes all audio frequencies *except* the one to which it is set. Thus, all other audio frequencies are fed back to the input to oppose wall input frequencies except one frequency. The overall result is an audio peaking stage at the one frequency to which the audio filter is set.

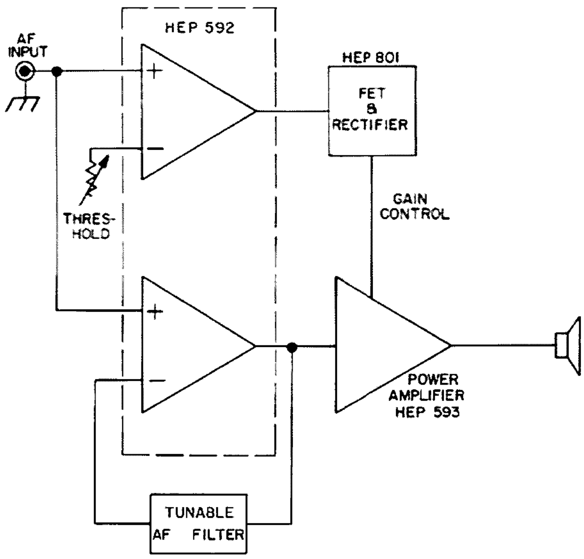


Fig. 1 Block diagram of accessory unit stage functions. Other similar IC operational amplifiers can be used to perform the same functions.

New Products

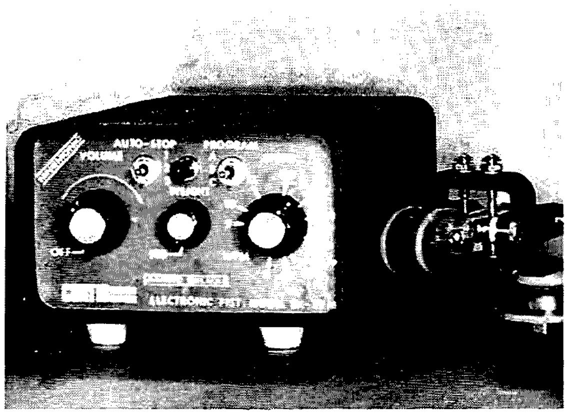
Automatic ID in Electronic "Fist"

Curtis Electro Devices has announced an advanced mnemonic integrated circuit keyer incorporating an automatic solid-state identification message generator in addition to the basic "Electronic Fist" circuitry. A custom integrated circuit read-only memory, febricated on a single silicon chip less than 0.1 in. square, controlled by three complex medium-scale ICs, provides permanent memory to generate the repetitive calls used by radio amateurs in normal and contest operation.

As an example, the selector might select any one of the three sequences below from a single memory:

- CQ CQ DE WA6JNJ K
- CQ FD CQ FD DE WA6JNJ K
- DE WA6JNJ K

Three auto-stop selections allow continuous cycling or a choice of two stopping points. In the manual mode, the keyer provides 8 — 50 wpm paddle or squeeze keying with dot memory,



independent weight control, and iambic character generation. A tap on the straight key of a Brown Bros. CTL combination key initiates the automatic program at the *exact speed and weight* employed by the operator in the "manual" mode. At 20 wpm, a full sequence takes 15 seconds. The sequence terminates either automatically or by a tap on the dash paddle. The unit will operate both grid block and cathode keyed rigs. Power supply, monitor and speaker are built-in. All cables and connectors are provided. The EK-39M mnemonic unit, available either from dealers or direct, is priced at $179.95 complete except for the individually tailored plug-in memory which is ordered directly from the factory per user message instructions. It is priced at $59.95. For more information, write *Curtis Electro Devices, Box 4090, Mountain View CA 94040.*

HEP Replacement Kit

A new universal kit of semiconductors that will replace over 6300 different semiconductor type numbers is now available to service dealers from Motorola's HEP suppliers throughout the country. The kit contains 50 of the fastest-moving replacement semiconductors, according to Motorola HEP sales manager Art Baldensperger. Ten HEP 254s, germanium PNP general-purpose transistors; ten each of the HEP 53, 54 and 55 silicon NPN transistors; and ten HEP 170s (2-5A, 1 kV silicon rectifiers) in Motorola's "Surmetic" package. HEP is Motorola's sales program for making semiconductor devices readily available to the hobbyist—experimenter and to professional service dealers through a nationwide network of authorized suppliers. *Motorola Semiconductors, 5005 E. McDowell Rd, Phoenix AZ 80536.*

(cont. on page 80)

The power amplifier stage is necessary to raise the output level to drive a small loudspeaker and produces about 3/4 watt output.

The wiring diagram of the unit is shown in **Fig.** 2. A 10K potentiometer is used with the agc portion of the HEP 592 IC to set the threshold value at which agc action starts. It can either be brought out as a panel control or left as a trimmer adjustment. The tunable af filter is of the bridged-T type. As shown, a three-unit potentiometer is needed to cover the complete audio range up to a few thousand cycles. One could possibly make only two of the resistor legs variable, but the frequency range will be restricted to a few hundred cycles over which the network is effective. **Fig. 3A** shows an alternative filter network which can be connected between terminals 7 and 10 of the HEP 592 and which requires only one potentiometer. It is rated to be effective from 70 to 10,000 cycles, but only the components specified should be used.

Fig. 3B shows a simple noise limiter which can be connected either before or after the HEP 592. Advantage is taken of the fact that the IC units are operated with a dual-polarity power supply to allow biasing of the diodes for symmetrical clipping.

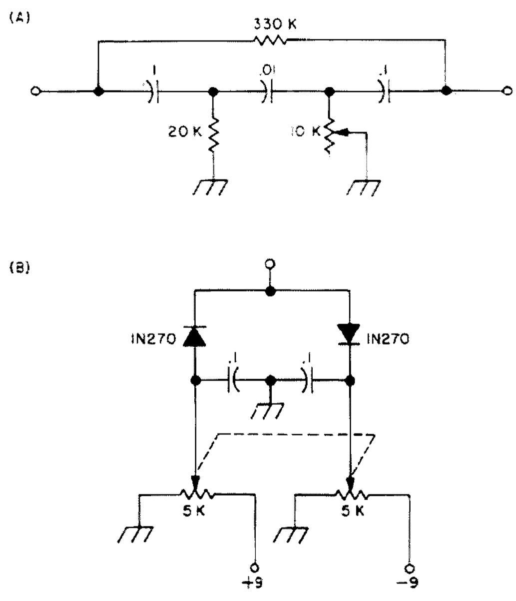


Fig. 3. Simpler audio notch filter (A) requiring only one potentiometer. Capacitors are Aerovox type P123ZNG. Symmetrical noise clipper (B) which can be used at input to unit or at input to power amplifier (pin 4).

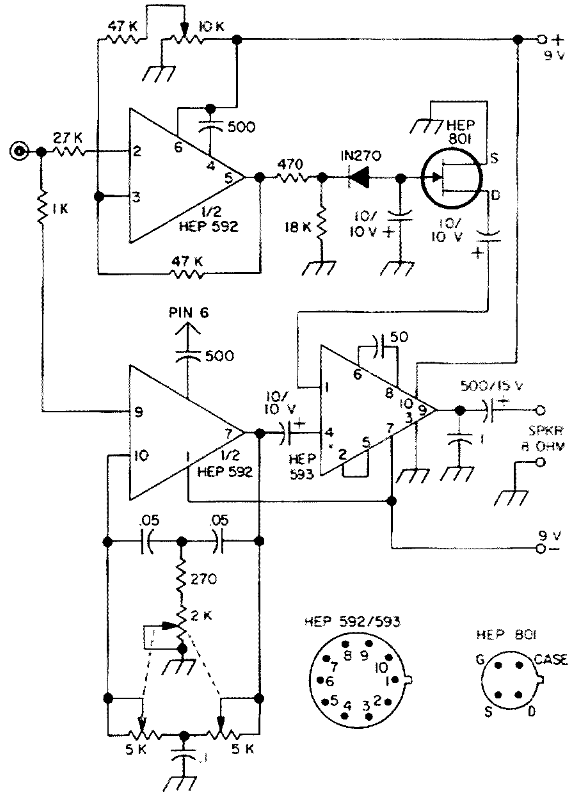


Fig. 2. Wiring diagram of accessory unit. Resistors are ½ watt. Triple section potentiometer used in audio filter is IRC type 45D502MD502MD202.

Construction

The photograph shows one construction layout possible for the unit. Basically, the circuit components are grouped around each IC and directly soldered together. The potentiometers for the agc and af filter are mounted directly on the perforated board stock. The potentiometers shown are actually of a miniature type but normal, less expensive ¼ inch shaft types are quite adequate. Also, although not shown, an IC socket should be used for the HEP592 unit, instead of directly wiring it, for protective purposes.

The use of the HEP 593 power amplifier appears simple from Fig. 2 and although its connections are not involved, its placement in a unit does present some problems. A heat sink *must* be used and Motorola specifically advises against the simple slip-on fin-type head sinks available for TO-5 transistor cases. They suggest a 2 inch x 2 inch x 1/8 inch piece of aluminum with a center hole drilled to snugly fit over the transistor case. Not having any material available, the author used a heat sink found on a surplus IBM computer board. The index tab was removed

(New Products cont. from page 78)

The Fantastic Dimmer

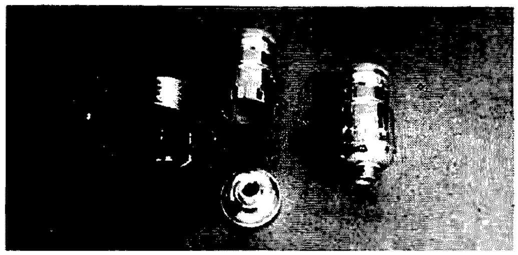
Voltaic International Corp. of Dallas, Texas, announces a solid-state electronic lamp dimmer socket. The entire dimmer circuitry is contained within what appears to be an ordinary lamp socket. However, the Volt-A- Lite, using an ordinary bulb, provides a full range of lighting intensity from a low glow to full brilliance. By allowing smooth, continuously variable lighting, it modernizes lamps, provides dramatic contrasts in home or office decor, and adds warmth, friendliness, and a relaxed atmosphere to any room. The Volt-A-Lite can be set low for a night light, adjusted to dim for watching TV or for parties or for romantic dining, turned to bright for reading, or adjusted to any level to suit any individual eyesight.

The money-saving features of the Volt-A-Lite far exceed its cost. To begin with, it does away with costly, short-life, 3-way bulbs, which are almost twice the cost of standard bulbs. The Volt-A-Lite lowers electric bills, too, by permitting lower light intensities when desired. Volt-A-Lite makes bulbs last longer, also, because the lamp dimmer socket always comes on at an extremely low level and feeds the current to the filament gradually. This reduces the damaging surge, of high current through a cold filament, that causes bulbs to burn out.

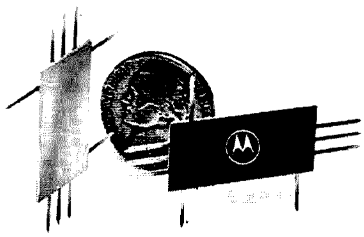
Installation is simple — just like the installation of an ordinary lamp socket. It requires only a screwdriver to remove the old socket and to attach the ends of the lamp cord to the two screw-terminals on the Volt-A-Lite.

The Volt-A-Lite operates at maximum efficiency with a 150W, 120V bulb but lower wattage bulbs can be used if desired.

The Volt-A-Light is Underwriter Laboratory recognized and is fully guaranteed, both parts and workmanship, for one year from the date of purchase. It's been overload-tested at twice its rating and has performed perfectly through 10,000 complete on-off cycles at its rated load. It does not heat up and does not interfere with radio or TV. It even has a current-limitng fuse element so that the Volt-A-Lite components are not damaged when the bulb burns out. The Volt-A-Lite is available by mail for $4.95 from *Voltaic International Corp., 7701 N. Stemmons Freeway, Dallas TX 75247.*



IC Duplexer



A new Motorola duplexer, the MCH5890, operates at frequencies between 400 and 500 MHz with up to 40W input. The MCH5890 features a typical 0.1 dB transmit-mode insertion loss and a typical 25 dB transmit-mode isolation figure. Although its primary purpose is as a transmit/receive switch, the MCH5890 will find use as a monitor network in transmitter circuits, as the sampling unit in afc or agc circuits, or other related communication applications. *Motorola Semiconductor Products Inc., Box 20912 Phoenix AZ 85036.*

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from the HEP 593 and a clean contact area between the flange of the IC and the heat sink established. The IC was then glued into place. Overall, the relatively low voltage gain (18-35) of the IC power amplifier, its cost and the necessity of using a heat sink does not compare too favorably with using two larger case audio transistors which do not require heat sinks at the 1 watt level.

Two 9 volt transistor batteries were used to power the unit shown. The battery potential slightly exceeds the 8 volt operating voltage recommended for the units but seems to cause no difficulty.

Adjustment & Operation

There are no real adjustments that should be necessary if proper layout procedures are followed. Some experimentation of the feedback resistors in the agc amplifier circuit may be necessary to obtain the best action and "bread-boarding" the circuit initially will save time later. The IC's did show some tendencies toward instability if too much coupling were allowed to exist between the various input and output circuits. This is understandable when one realizes that although the IC's are called "audio" type, their actual response extends up to several hundred khz. So, an rf feedback loop can exist which will overload the units but yet not produce an audible indication.

In operation, the receiver af output level is adjusted to produce adequate audio output, but not to the point of overloading the unit. The agc threshold control is set as desired to produce the best agc action when going from a weak to a strong signal.

Summary

Various other operational or audio type IC's can be used for this type of accessory unit so long as the device ratings are not exceeded. The main criteria is that the agc/af filter IC have differential inputs. One could, of course, also use separate IC's for these functions, each with a differential input.

Such a unit adds a significant degree of improvement to the operating possibilities of a SSB transceiver used on CW which does not have real provisions for CW reception. It also provides some very interesting exercise and experience in the many versatile uses to which IC's can be put. ... W2EEY

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INVERTED A ATTIC ANTENNAS

Hardly an issue of any ham radio magazine comes out without some description of a simple and efficient antenna system. I have spent years constructing various types of these systems with varying degrees of success. There is the matter of optimum height, but very often we find limitations as to the area and level at which the antenna can be strung. Then again, weather has much to do with our ambition, especially during the winter with the temperatures hovering around zero, and the snow six feet deep. Rain and the hurricane seasons play their part in delaying the fun of experimenting with the new antenna ideas.

The antennas described below eliminate most if not all of these problems. They also fill certain needs peculiar to the ham fraternity. All of the units are built in the attic of a private home, and are compact, inexpensive, and easy to put up. They are as concealed as an antenna can be for those who need this for esthetic or other reasons. As to height, they are built into the topmost portion of the house and many towers do not go much higher. The big advantage is that you can work on them winter or summer, and no storms can affect them.

My first inspection of the attic showed me that I could not cram in a full-size half-wave antenna in the bands from 10 meters and below. The attic was built with a peaked roof held up by heavy beams. I decided to bend my dipoles on these wooden beams with the apex at the top. The result was the inverted-V dipole antenna.

My interest at the time was to fire up on 15 meters. I was not getting good results with the ordinary dipoles and folded dipoles I had set up outside.

For more rigid mounting and possible broader band operation, and the fact that

they are easy to mount, I decided to use ordinary thin-wall electrical conduit for the elements of the antenna. These come in the half-inch size at a standard length of 10 ft and are quite inexpensive. The 10 ft length is short for 15 meters, but with the addition of end-loading or center-loading coils I hoped to be able to get the antenna to resonate within the 15m band.

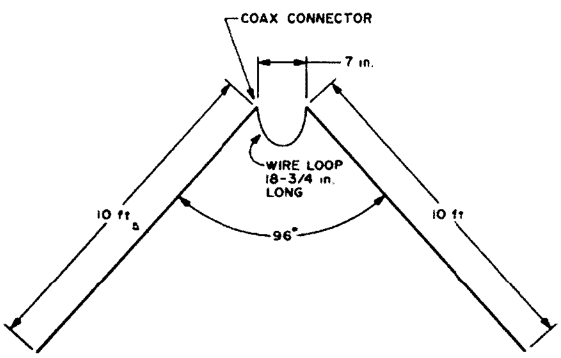

Fig. 1.

The configuration of the elements is shown in the diagram in Fig. 1. The attic beams happen to be exactly 96 degrees from the apex. Each 10 ft element was mounted on two ceramic standoff insulators placed at either end of the tubing. To hold the tube to the standoff a 4 in. strip of scrap aluminum was wrapped around the conduit. The ends of the strip were drilled to accept a screw which tied the strip to the standoff as shown in Fig. 2.

The ends of the coax cable can be soldered directly to the apex elements. However, if it is desirable to change the coax cable to other antennas, coax connectors will make it simpler and less expensive.

Spacing between the two pipes at the apex was found to be better at 7 in. Finding the correct center-loading inductance took quite a bit of time and experimentation. An ordinary length of hookup wire 18¾ inches long soldered between the soldering lug and the center conductor of the coax junction (Fig. 1) gave the lowest swr readings. Figure 3 shows a picture of the apex connections.

I made a few swr checks before trying the antenna and was pleasantly surprised to find them very low.

10m Attic Antenna

I used the attic V antenna on 15m for two years and was so amazed at the results that I decided to see how a 10 meter version (Fig. 4) would work out. No center loading was found necessary. I drilled the element ends and tapped for 8–32 screws and soldering lugs. I connected the coax directly to the apex ends of the elements as shown in Fig. 5.

In cutting the conduit, I found that a pipe cutter did a better job than a hacksaw. The cut ends are cleaner and do not require filing as they would after being cut by a hacksaw. Figure 6 shows how the cutter is used.

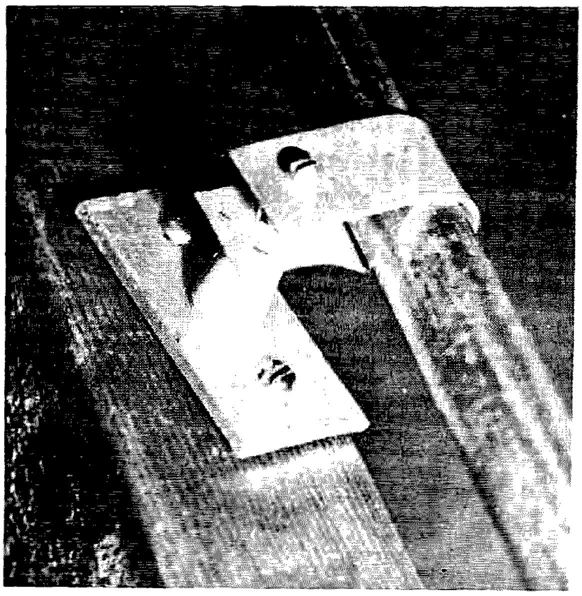

Fig. 2. Strips of aluminum hold the element to the ceramic standoffs.

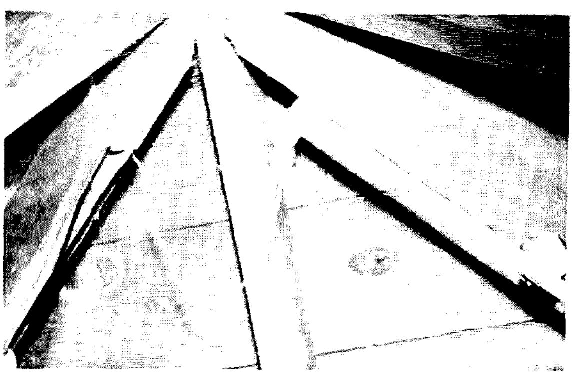

Fig. 3. 15 meter inverted-V apex connections.

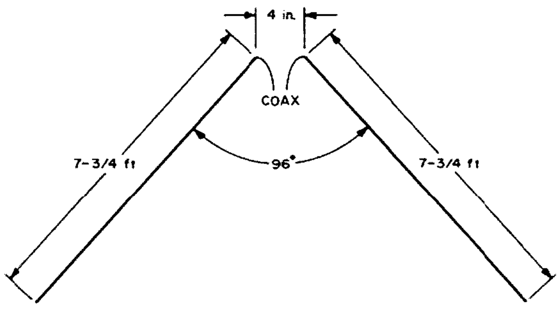

Fig. 4.

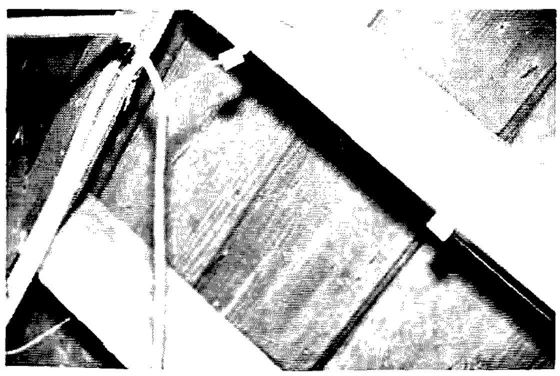

Fig. 5. 10 meter inverted V connections at apex.

20m Attic Antenna

After the successful operation of the two antennas was assured, a more ambitious attempt was made to put a 20m inverted V in the attic. This involved the use of loading coils at both the element ends and the center apex. A diagram of the layout with dimensions for the antenna is shown in Fig. 7.

Two 10 ft half-inch conduits were installed on the attic beams using ceramic standoffs. Spacing between the two pipes

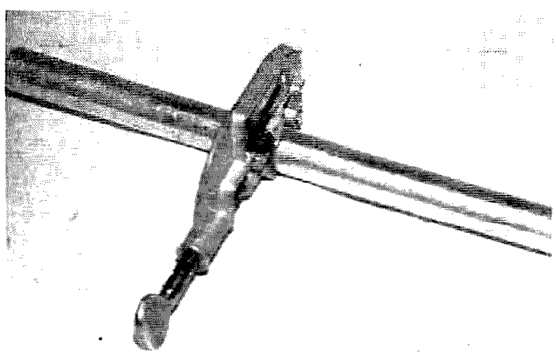

Fig. 6. Using pipe cutter to trim ½" conduit.

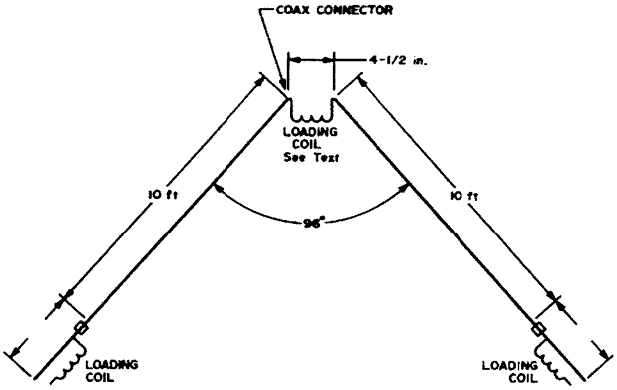

Fig. 7. Antenna layout.

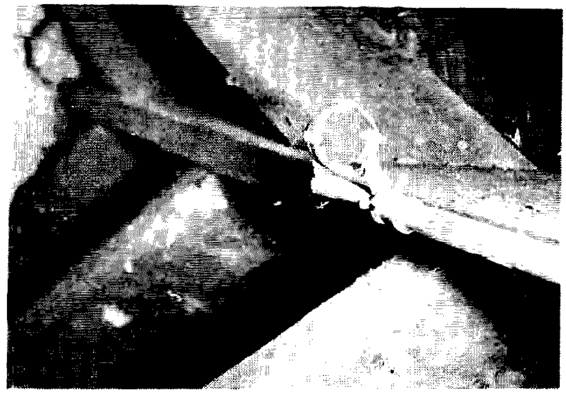
Fig. 9. Coil mounted on antenna element.

at the apex was set at 4½ inches. At the far ends of the conduit a coupling unit was attached to each element.

Two 6 in. lengths of half-inch conduit were cut and a hole was drilled about ½ in. from one end and 1-1/8 inch from the other end. A metallic standoff was mounted at the hole 1-1/8 inch from the end while a ceramic standoff was placed at the other end.

A B&W air inductor 1¾ inch in diameter (9 turns per inch) was cut to eight turns and mounted on the two standoffs. Construction details are shown in Fig. 8.

When completed, these units are plugged into the conduit coupling with the metallic standoff closest to the antenna element as shown in Fig. 9. At the apex one of the elements was flattened and drilled to accept a coax fitting. The other element was drilled to accept an 8/32 and soldering lug.

At the apex a 5-turn B&W coil (1¾ in. diameter) was mounted between the coax fitting and the soldering lug. Figure 10 shows the mounting at the apex. A switch is also pictured which I used to vary the inductance of the center loading coil when adjusting the antenna for swr.

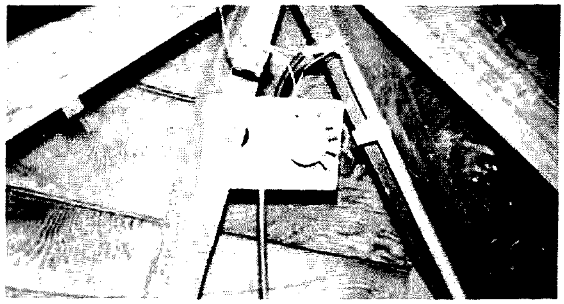
Fig. 10. Center loading at apex of 20 meter inverted V antenna.

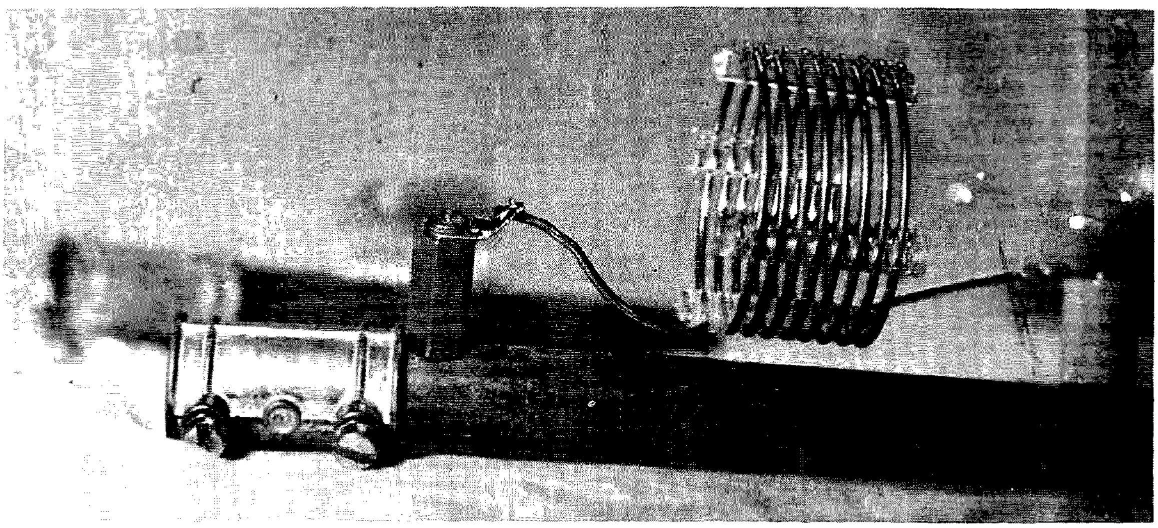
Fig. 8. End loading coil for 20 meter inverted V.

In my own station I use a coaxial switch to change antennas. I estimate the total cost for the three antennas at less than $15, which is quite good for a three-band instat-change antenna system.

. . . W2SF ■

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Audio Motive Co.
State College PA 16801

DOUBLE-BALANCED MIXERS

Although the heart of the single-sideband system, the balanced mixer or modulator, did not originate with SSB, it certainly became more well known to the amateur fraternity when this mode of transmission became popular. In the way of background for the newcomers to amateur radio, or review for the Extra and Advanced classes, the common, single-ended mixer or converter produces three output frequencies. These consist of the original carrier or local oscillator frequency and the two sidebands – products of the sum and difference frequencies of the carrier and modulation. The balanced mixer produces only the two sidebands, the carrier frequency being greatly attenuated by the conversion process. The advantage of the balanced mixer is obvious for SSB operation since we need only to provide a filter to get rid of the unwanted sideband before passing the signal to the final of the transmitter. Balanced mixers are not limited to sideband transmitter use, but find applications throughout the electronic world.

Common Configurations

In Fig. 1 the circuitry of the ring modulator used by telephone companies for many years in landline communications is shown. The older models used metallic copper oxide diodes in the ring formation with balanced input and output transformers. Besides the high signal loss

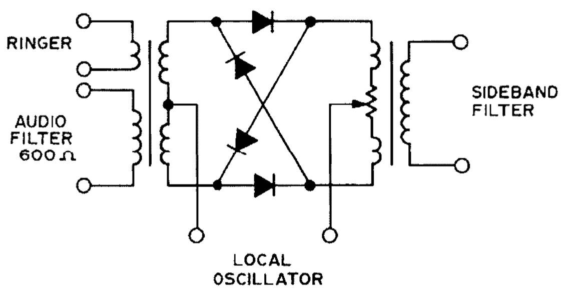


Fig. 1. Telephone company ring modulator.

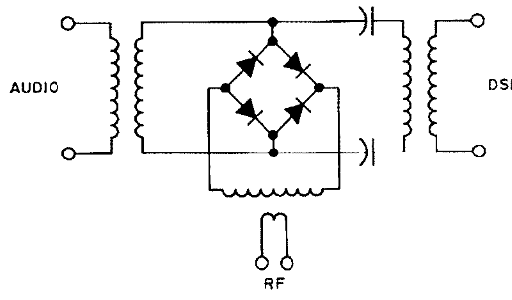
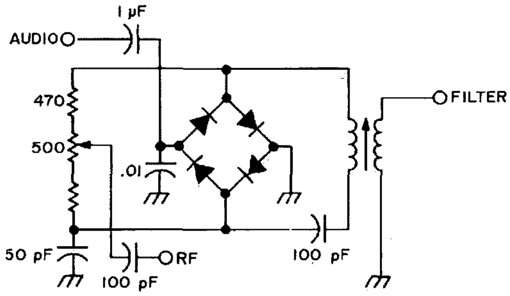


Fig. 2. Balanced bridge modulator.



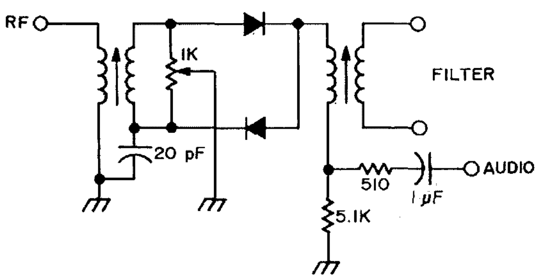
RING MODULATOR W/O BALANCED TRANSFORMERS

Fig. 3. Ring modulator without balanced transformers.

encountered with these types of diodes and the expensive balanced transformers, the frequency range of the transformers is about 50 kHz. Note that a 100Ω resistor is still used to "balance out" any component variations. Although a high ratio of input vs local oscillator level is necessary to drive this circuit, the output will show a local oscillator attenuation of at least 60 dB.

Less efficient is the bridge type of balanced modulator shown in Fig. 2. Balanced transformers are still necessary in this type of configuration and the diodes should be matched. The signal is effectively shorted by application to opposite sides of the bridge in the balanced condition. The presence of an audio signal unbalances the bridge allowing a double sideband to appear at the output. Carrier isolation may approach 50 dB with matched components.

The most expensive components of the balanced mixers shown in Figs. 1 and 2 are the balanced transformers. In designing a circuit without balanced transformers we not only cut the cost significantly, but also have the oportunity of utilizing an rf input of the desired transmitter output frequency for single band operation, or a

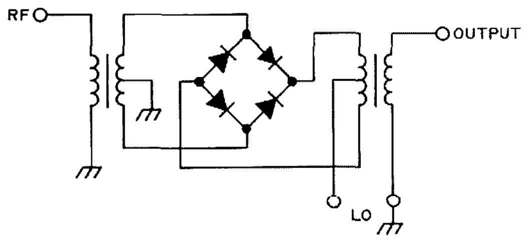


2–DIODE RING BALANCED MODULATOR

Fig. 4. 2-diode ring balanced modulator.

frequency more easily converted for multiband operation. A common balanced modulator without balanced transformers, for ham use, is shown in Fig. 3. Notice that the matched diodes are connected in a ring rather than a bridge configuration. Good shielding procedures and matched components give a typical carrier attenuation of 40–45 dB.

It is not necessary to use four diodes to form a balanced modulator. As shown in Fig. 4, a two-diode balanced mixer in ring formation is also possible. However, the



DOUBLE–BALANCED MIXER MODULE

Fig. 5. Double-balanced mixer module.

circuit lacks the efficiency and carrier suppression possible with the previously discussed modulators.

Thus far we haven't said anything about the possibility of obtaining signals from the output of the balanced mixer other than the double sidebands and the attenuated carrier. Good efficiency and low distortion are possible by driving the mixer with a signal much higher in frequency than the input, and of greater amplitude. The general rule of thumb states that a ratio of 10:1 should be used. Thus, the higher the input amplitude, the greater must be the signal to drive the bridge. Consequently, undesired mixing products are found at the output. Fortunately, the even harmonics are suppressed by the 180-degree phase shift operation of the circuit, leaving only the odd harmonics. Of these, the third order harmonics will be the strongest but should be easily attenuated by the following sideband filter. In other types of mixers, such as the single mixer or unbalanced modulator, both even and odd harmonics are present at the output.

Within the last few years, the balanced mixer has taken on a more modern appear-

ance, and in some cases, advanced design in the form of integrated circuitry. Much of this change has come about as a result of new or improved components such as the Schottky barrier diode, toroid coil forms, and transistors with greater parameter ranges, notably FETs and MOSFETs. Probably the first new development which contributed to more efficient balanced mixers was the availability of matched diodes bearing a single type number and at a cost which put them in easy reach of the amateur and experimenter.

A number of companies began to offer encapsulated balanced mixers using matched components for less conversion loss and balanced transformers with toroid cores for better isolation. These double-balanced mixers ranged in frequency from 200 kHz to 500 MHz with insertion losses typically on the order of 7 dB and carrier or local oscillator isolation figures of 30–40 dB. The advantages of such a module included no dc power required, relatively economical when compared to iron core balanced transformers, and ease of circuit board mounting. In addition, these modules found application as frequency converters, product detectors,

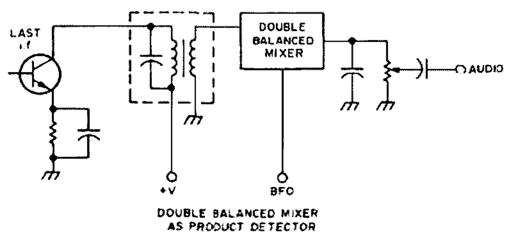
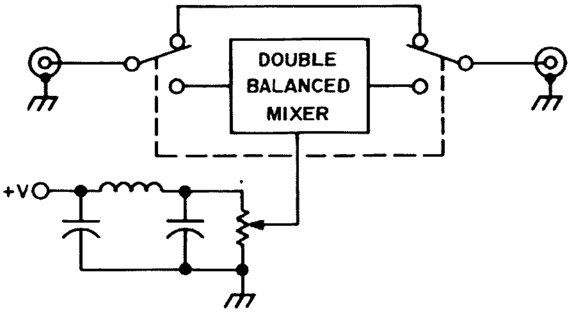


Fig. 6. Double balanced mixer as product detector.

phase detectors, voltage controlled attenuators, and summing networks, to name a few. The double-balanced mixer modules assume the general circuit of Fig. 5. In general, the input/output impedances are 50Ω and the output is dc tapped. This latter characteristic allows the module to be used in such applications as a voltage-controlled attenuator, whereas an incorporated coupling capacitor would preclude such operation. A product detector designed with a double-balanced mixer is



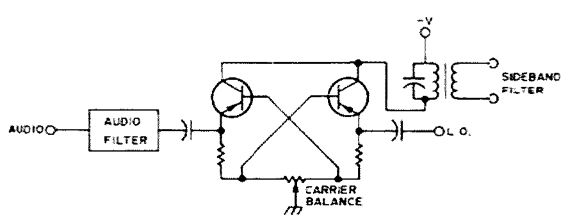
VOLTAGE VARIABLE ATTENUATOR

Fig. 7. Voltage variable attenuator.

shown in Fig. 6. This circuit has the advantage of immunity to large signal overloading, but requires a high injection level.

A voltage-variable attenuator can be made by varying the conduction of the double-balanced mixer with applied voltage, as shown in Fig. 7. A potential of 1V is enough to provide approximately 40 dB attenuation. Due to the series connected diodes of the mixer, current should be limited to less than 60 mA. For practical purposes, the attenuation/voltage ratio will not be linear. However, a front panel control can be calibrated to provide the attenuation readout.

Although conversion loss is unavoidable when using diode configurations, transistors lend themselves readily to double-balanced mixer circuits which not only overcome the conversion loss, but also exhibit some gain. The cross-coupled transistor circuit shown in Fig. 8 also does away with the costly balanced transformer. Operation of this circuit is similar to multivibrator action. One transistor is always on while the other is off. As the phase of the carrier wave changes, the on/off state of the transistors also changes, producing a pulse across the common collector load. When the balance control is



TRANSISTOR DOUBLE-BALANCED MIXER

Fig. 8. Transistor double-balanced mixer.

properly adjusted to null the carrier, the output signal will consist of upper and lower sidebands of the two input signals. The undesired sideband and the even harmonics of the inputs are removed by the following sideband filter. Input impedance for the transistor double-balanced mixer is approximately 50Ω while the output impedance approaches 600Ω. A local oscillator/signal ratio of 10:1 is maintained for best efficiency. Isolation of carrier/signal/output when using this circuit, requires short lead lengths and shielded cables. Building the entire circuit in a shielded "black box" with coax connectors may add 10 dB to the carrier/output isolation. A conversion gain of 5 – 10 dB is possible, but most efficient operation usually produces no more than 3 dB gain.

Even the telephone companies are modernizing their modulator circuitry by replacing the diode ring modulators used for so many years. A number of manufacturers of integrated circuits are producing interesting designs on monolithic substrates of single chips, the whole can being less than the size of a quarter. Amperex Corporation has been producing its silicon monolithic ring modulator/demodulator since 1967. It is known as the TAB101 integrated circuit, and consists of four transistors on a single chip enclosed in a TO-74 can. A possible balanced mixer circuit utilizing the TAB101 is shown in Fig. 9.

Double-balanced mixer applications are limited only by one's initiative. A closed-circuit TV system transmitting terminal as seen in Fig. 10, allows inexpensive short-

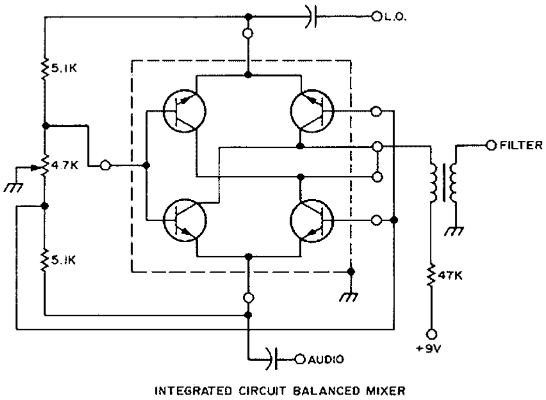


Fig. 9. Integrated circuit balanced mixer.

link transmission. The double-balanced modulator provides double sideband signals of 4.5 MHz bandwidth which are transmitted by cable to terminal equipment.

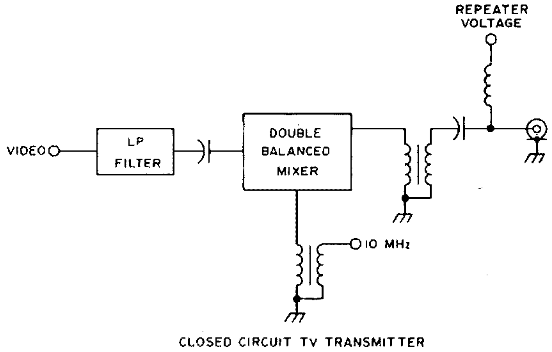


Fig. 10. Closed circuit TV transmitter.

Mototola claims to be first with a true linear, 4 quadrant multiplier integrated circuit. The MC 1595 integrated circuit is designed for uses where the output voltage is a linear product of the two input voltages. Some examples of possible applications include digital multiplication, division, square roots, mean square, and frequency doubling. It may also be used as a balanced modulator/demodulator, amplitude modulator, or electronic gain control.

Motorola has also recently managed to produce an FM demultiplex circuit on a single chip. Although production is limited to Scott for their tuners, such circuits promise to be both readily available and economical in a very short time.

Due to the high input impedance, low power supply voltage and current required, and versatility of such integrated circuits, they are easy to breadboard and provide a solution to bench design. Instead of a small pile of different transistors, now all you need is the IC and a small pile of resistors and capacitors.

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. . . K3PUR ■

Quick and Permanent TOOL MARKER

Jim Kyle K5JKX

The craftsman is proud of his tools, the saying goes, and with the price of tools nowadays it makes good sense to mark them well, proud or not.

Here's a trick borrowed from professional electronics service engineers which makes it easy to mark tools or any other metal objects quickly yet permanently.

Simply take an ordinary wooden pencil and sharpen it draftsman-style, with a long exposed lead (Fig. 1). Next, rig up a 24V transformer with a utility plug on the primary so that it can be plugged in, and flexible test leads terminated in alligator clips on the secondary winding. The transformer should be rated for at least 1A, and the higher the current rating the better – but we used one of the bargain specials sold by Radio Shack which happened to be left over from a +24V power supply that never got built, rated at 900 mA.

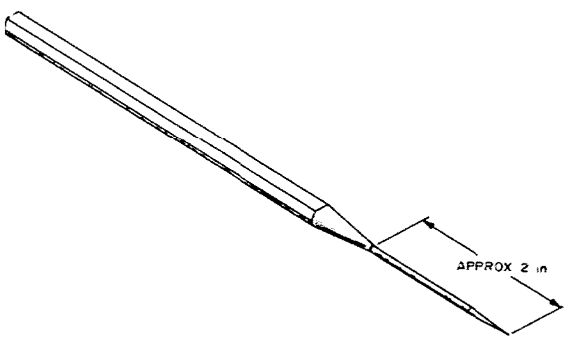


Fig. 1. An ordinary draftsman's pencil with an extended point will serve as the basic "engraving" device. The lead must protrude enough to allow connection of a clip-lead "electrode."

Connect one of the alligator clips to the tool or other metal object to be marked, and the other clip to the exposed lead of the pencil (Fig. 2). Now, using the pencil just about like any other pencil, write your name or other identifying mark on the tool.

The small arc which strikes between the carbon tip of the lead and the metal work surface etches away the metal of the tool, leaving a permanent mark wherever the pencil passes so long as the arc remains struck. It takes a bit of practice to learn to hold the pencil just far enough from the metal to maintain the arc, but you should achieve excellent results by the second try. Take caution – the lead gets hot, and if you keep things going too long the wood of the pencil may burst into flame. Everything cools down more rapidly than a soldering gun, though, when you move the lead away from the work.

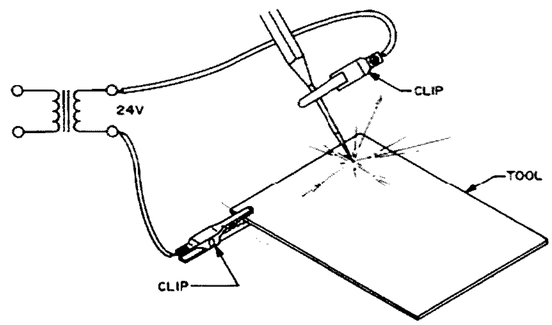


Fig. 2. When a fairly high voltage exists between the work and the marker, you can strike a thin arc and use it to trace your copy.

The pencil lead vaporizes during the course of the process and leaves a heavy black mark on the metal. This is *not* the permanent mark you need; it should be washed away with solvent or wiped off with a dry rag. Beneath the black film, you should find a row of tiny craters, one for each half-cycle of the 60 Hz power as the pencil lead moves over the work – they are the permanent marking.

In addition to using this trick for marking tools and occasionally identifying terminals on breadboard chassis, we found it most convenient for writing identification on the many keys which burden our pockets. You will probably think of many other uses, now that you know about it.

. . . K5JKX■

The Rev. John O. Gardiner W6LZJ
1841 Locust Ave., Apt. No. 7
Long Beach, CA 90806

There is a SANTA But...

Yes, there is a Santa, and I'm going to tell you all about it. It was getting close to Christmas as I picked up a back issue of 73. Naturally, no one in his right mind ever begins reading from the front cover straight through to the last page, and I am no exception to this phenomenon in the habits of the American reader. I had read the *Never Say Die* editorial, and after pondering for a while Wayne's words of wisdom I let my fingers stroll idly where they would among the pages, stopping now and then to read an article about sunspots, carrier (in my SSB signal; never! . . .or nearly never!!) suppression, or that upstart new VHF mode.

Now, I can't tell you exactly when it was or how it happened, but, I must have begun to read the advertisements aloud to myself. Let me warn you now: never do that, and if you do be sure you never say, "Boy, wouldn't that be great to have. Why, every ham in the country would give his eyeteeth to own one of these!"

A few of my friends (even Wayne Green) talk from time to time about ESP. I don't know much about ESP, nor about how it works. Therefore, I must leave it to the gentle reader to decipher in his own mind the probable explanation for these things. Meanwhile, back to the *73 Magazine* and how I found out about Santa.

If you do decide to comment aloud while you're reading the delightful ads, be absolutely certain that you take your time. Don't rush into the experience without due thought and sufficient concentration.

By this time, you may be thinking that this is much ado about very little. Please read on! What transpires here may someday happen to you. As I have said, I can't rightly recall just how I happened to be reading aloud certain comments on the delightful items displayed in between the articles of 73. I had perused with silent longing the "Quality People." Rohn, the largest tower manufacturers in the United States, are best known for foldover and crank-up towers. I don't own a Rohn; I don't even own a tower! On page 113, I literally drooled, as I read about the Classic 36, six element, 10, 15, and 20 meter beam by Mosley Electronics. I don't own a beam any more. I don't even own a rotor, let alone a rotor like the Ham-M listed on page 112.

I had noted all the goodies listed between pages 112 to 122. I might have mentioned aloud that I would like to own a tower, a rotor, a brand new National or Galaxy transceiver, a Swan Cygnet, or even a Henry linear. I even remember thinking that Wayne had done a fine job of listing the products of his advertisers.

Perhaps it was the wonder of it all – that great parade of electronic perfection lined up before me; I may have even pictured them, one and all set in their

rightful places side by side in my humble shack. The tower and rotor excepted, my shack wouldn't hold them, but how nice they would appear standing in the yard with the Mosley tri-bander atop and pointed toward Europe.

In thinking back now, had you asked me about Santa, whether I believe in him or not, I would have given you the standard answer. After all who can say how many youngsters read the words of truth as they are expressed in 73? But – and here's the rub – I never gave it a thought that he of all persons would be listening as I read those precocious ads. Who knows now what treasures might now be installed in my shack? Surely, I could have been the envy of hams on either side of the Pacific and the Atlantic not to mention the Antarctic.

Just as I had thumbed the pages of 73 to page 21, someone handed me a BLT (bacon, lettuce, and tomato sandwich). I munched away enjoying the savory treat when suddenly my eyes lit upon the Dow-Key advertisement. Imagine my thoughts as I read about the SP6T, remote 115V ac. One could install this remote controlled relay atop his tower, and with but one length of coax feed six separate antennas one at a time to the rig sitting in the shack. "Wow," I think I said. "Oh, double wow! That must be the ham gift for the ham that has everything." Note carefully what I say next. "Boy, I wish I had one of those."

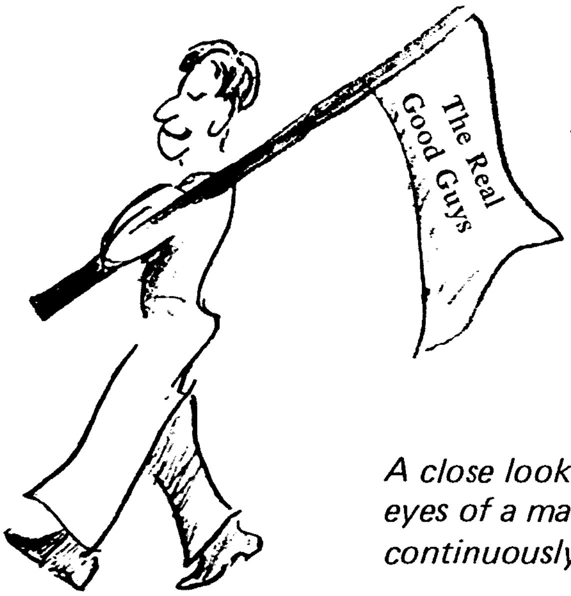
As it turns out they were fateful words. In my stocking (I have unusually large feet) on Christmas morning. . .you guessed it; a real genuine, shiny, brand new Dow-Key SP6T, remote 115V ac six-position relay.

There *is* a Santa. He was listening. Can you imagine my surprise when I looked in my stocking? No tower, no rotor, no beam, not even any fancy ham gear, still I'm the proud possessor of one of the finest relays ever made.

By the way, OM, if you know anyone who owns a Rohn tower, has a Ham-M rotor, and uses a Mosley Classic beam, but doesn't own an SP6T by Dow-Key, will you ask him to get in touch with me?

. . .W6LZJ

A NEW START FROM WASHINGTON



Wells Chapin W8GI
2775 Seminole Road
Ann Arbor MI 48104

A close look at the ARRL through the eyes of a man who has been a member continuously for 46 years. . .

Belonging to the ARRL is rather like being a stockholder of a large corporation where you have the privilege and duty to be constructively critical. Notice the word "rather" was used because a large corporation would not countenance the things that have been going on. When you are losing your shirt, losing your image, your growth has stopped, young people are not interested, your people are getting old, and no new blood is entering, when people are using and taking your bands, when your ranks are divided, when you are running a publishing house and not tending to your basic objectives, when every other service that has an interest in using rf spectrum has a representative and lobby in Washington, when you buttonhole a senator and ask him what he knows about amateur radio and you draw a blank, when you have a board meeting where the cards are stacked so that the present ARRL headquarters crew can have time to prepare a defense, and two CB publications, one of which is owned by the same group who owns a ham magazine, recommends taking part of our 2 meter band – things just cannot be right. Believe me, if this were a large corporation, heads would roll and changes would occur.

In the days of Hiram Percy Maxim, when we were not running a publishing house and book store, things went along pretty well. Along with Maxim, came A.A. Herbert, who also was dedicated. Then another name entered the picture, K.B. Warner, and the controversy started within our ranks. As you look back, you can see the jockeying for power within the ARRL headquarters personnel with Mr. Warner succeeding and bringing up his favored few.

It is interesting to note that as you read "200 Meters and Down" and "Fifty Years of the ARRL," they are all good guys, everything was sweetness and light, no controversy – yet the truth of the matter is that these written documents are both by ARRL members who were headquarters people. For you newcomers, controversy swarmed around K.B. Warner, former editor of QST and officer of the ARRL, and his strong methods of ramrodding what he thought was best.

Those Warner days were hectic days. During that period a lot of dedicated hams beat their heads against the wall, just as many are doing today. The Chicago Amateur Radio Club and the Egyptian Radio Club got together and elected two directors. A west coast group got together and published a magazine and printed the other side of the story, but they were not strong enough to effect a change. Their efforts faltered and the ARRL succeeded in killing them off. You don't read about this

history in any of the ARRL history publications.

A good deal of the Warner philosophy and work still remains: stacked board meeting agenda, headquarters knowing all the answers, everyone more interested in running a publishing house than saving our bands, without them we don't need a $2 million headquarters building, the ARRL, and its headquarters people.

It is easy to be critical; it's more difficult to supply the answers. You must define the problem before you try to solve it. With this thought in mind, let's suggest a few answers to some of the more obvious problems.

Board Meetings

Why hold them behind closed doors? Why not handle them like a good corporation does? Let's have a report on the status of our hobby at a meeting where every member can attend and vote. What's wrong with democracy? Let's have a good old stockholders meeting like some of the more stormy recent auto company meetings where effective changes were made by the rank and file. How about having a session at the meeting, for open discussion, for the good of ham radio? What's wrong with hearing from some of the brilliant minds found in our ranks? If you cannot set up a stockholders meeting (since we are all stockholders of the ARRL, each should have his voting right on all facets of our business), the very least that should happen is that a new method for handling board meetings be set up so that an inflexible agenda is thrown out and that directors can bring any subject to the floor without being called out of order. All hams should belong to the ARRL; and that takes me neatly into my next subject.

A House Divided

The ARRL represents less than 50% of the total number of amateurs. Thus, how can it truthfully claim to represent ham radio? If you published the same article in all three ham radio publications, you still would not reach all the hams. To make matters worse, even within the ARRL, due to poor leadership at headquarters (or perhaps lack of it) our own ranks are divided. The FCC, with whom we coexist, has lost some of its respect for the ARRL. What do you do to solve this problem? Unfortunately, this problem of a house divided ties very closely into our failing image, the lack of knowledge about amateur radio of the general public and our Washington representatives and foreign governments. The answer to this problem just screams "Public Relations."

Let's hire a public relations man and have his first duty to establish a mailing list of all hams and tell them the ARRL story (of course we've got to clean house before we can tell the story). His first objective is to have all hams belong to the ARRL. In addition to supplying us with the usual handy dandy public relations kit on how to write stories for newspapers he would be the clearing house for important contributions to amateur radio and would disseminate this information nationally. His next duty is to establish a congressional mailing list, a foreign hams mailing list, and others. He does this from his office in Washington. He lunches with FCC and congressional people daily. He takes the train to New York and gets acquainted at the UN and tells the amateur radio story there along with stories from foreign counterparts of the ARRL. This would be the first step in moving our headquarters to Washington, where it should have been in the first place.

Washington Headquarters

With a Washington headquarters, this would be a good time to separate the publishing house from the ARRL, and perhaps QST could then print both sides of the story just as Broadcasting Magazine does for the National Association of Broadcasters. Broadcasting Magazine is the bible of broadcasters and presents a very good version of all sides of each problem. The magazine is separate, owned by another source, specializes in broadcast news, and really is the voice for broadcasting. Incidentally, both the magazine and the National Association of Broadcasters are in Washington, not Newington, Conn.

While we are on the subject of a lobby in Washington, a little insight as to the magnitude of lobbying can be obtained by reading the Congressional Record, Volume 115 #83, dated Wed. May 21, 1969. There are over 5000 names listed, many fine companies and many associations, all in Washington where the action is – not in the wonderful quaint little town of Newington, Conn. where the action ain't. As you go through the names, you find hundreds that could be drooling over the valuable spectrum we occupy. Now pick up the May 1970 Yellow Pages of the Washington telephone directory. There are eight pages of associations and as you meander through them you find hundreds that are associated with some use of the radio spectrum. Take a look at Broadcasting Magazine yearbook for 1970 and find pages of consulting engineers who make their living getting spectrum for their clients, and pages of Washington lawyers doing the same thing. Do any of them have a Newington address? NO! They are where the action is, not where the inaction is. Funny thing, in 5000 lobbyists, 8 pages of people associated with lobbying, scads of pages of people representing spectrum users – *not a single mention of amateur radio!* So let's have the board of directors look into separating the publishing business from ARRL. Let QST be the official organ for all, repeat *all*, amateurs, and at the same time, make a start at Washington representation by establishing a public relations office. Why doesn't the board of directors establish a study group looking toward these goals?

Our Bands are Diminishing

Take a look at the following chart. The heavy load of amateur radio is carried in the 160, 80, 40, and 20 meter bands. Yet, see what has happened here over the years in terms of total bandwidth.

Band (meters)	1927	1938	1946	1963
160	500 kHz	285 kHz	300 kHz	200 kHz
80	500	500	500	500
40	1000	300	300	300
20	2000	400	400	350

This chart does not tell the whole story. Forty meters is practically useless at night due to the intruders in our bands, all there by agreement of the U.S. with no objections at the proper time by the ARRL. Had we had a group whose sole job is to hold our bands, they might have been able to stop many of these intruders before they went on.

This loss of bands is a subject in itself. There is a crying need for a complete plan of attack, not only to keep our bands, but to expand our privileges. The ARRL spent a paltry $100,000, which was eaten up by a few trips to Europe. The broadcasters, only one of the many groups lobbying for spectrum have within their own National Association of Broadcasters (NAB), at least seven very powerful and active lobbies. Their clear-channel AM radio association and the association for maximum service telecasters spend millions to keep their place in the spectrum. We, as amateurs, don't even recognize the full magnitude of the problem. We do not have a permanent group whose sole job is to conserve our radio spectrum.

What's in a Name?

Good business dictates that your name is important. If possible it should reflect your image. Corporations spend millions advertising their trademark and name. Some of the larger, after years of using the same trademark, recognize that to keep in tune with the times they must change. RCA, for instance, has dropped the little dog sitting in front of the phonograph and in addition streamlined their trademark. We hams, in the USA, have doggedly hung on to ARRL. Our British friends have a real slick title, RSGB – Radio Society of Great Britain. The RSGB really reflects the amateur image a great deal more realistically than the ARRL. Amateur has two meanings, one has a nasty intonation, and the other truly reflects our basic purpose; but the general public whom we must sell in order that they will let us keep our bands, always look at us in the derogatory manner. Why not follow Great Britain and use the Radio Society of the USA, or the Institute of Amateur Radio or some other more useful descriptive title. A name is important as that always hits the general public in every news release. As part of our new image let's discard the old and come up with a new name that is in tune with

the times. There is nothing sacred about ARRL; if RCA can drop their doggie after selling it for 35 years, I guess we can do the same.

Everyone resists change

The old ARRL dog must learn new tricks or it will be dead. Corporations that have resisted change have long since been buried. The business highway is strewn with the dead bodies of companies who resisted change. We just cannot afford to be like the company that wouldn't stop manufacturing buggy whips. We are living in a dynamic, changing society. Communication is reshaping the world, and we are part of this communication revolution. We desperately need leaders who will not resist change and who have the moxy to fight for change.

Summary

It is obvious that the ARRL needs changes to get in tune with the times. It is also obvious that we must support the ARRL or some new name, as a total group. Divided we can be conquered, united we stand a good chance to survive. Let's ask the embarrassing questions and be sure we give realistic answers. You cannot cure a person who has an ingrown toenail when you diagnose his problem as a cold. The first step is to recognize that a problem exists and then define it and then solve it. I'd like to start with the first question, what is in a name? Next question, what's our purpose in life and in our nation? Next, should QST and ARRL be one and the same? How do we get all amateurs to support one action? Do we need Washington and world representation? Do we have a future? What future? What part will we play in the 1880s? Is there really a problem or is it normal to have less than 50% of the hams belonging to ARRL?

My last comment, and this is strictly personal: For years I have been advocating change because I recognized it was necessary. It is my feeling that the ARRL headquarters people just sit back and hope that I and the others who have been advocating change will run out of steam. What they don't realize, or perhaps don't care, is that if things don't change, they will be out of jobs. The ARRL will be defunct, their pension will be gone, and they will have to live on social security like the rest of us.

. . .W8GI■

AMATEUR RADIO LICENSE STUDY GUIDE

STAFF

From time to time, the Federal Communications Commission adopts new questions to use in the amateur license exams. 73 has tried to keep up with the FCC in incorporating the new questions into the published "study guide" series, but of course this cannot always be possible. The Extra class series, for example, has already been published, as has the Advanced. This chapter of our series, then, contains a complete list of all FCC study questions. These questions will provide the update needed to complete the formerly published courses, and will provide a preview of questions yet to be covered in the current General class series.

If you're studying for your FCC exam, now is a good time to de ermine whether or not you're ready for the trip to the FCC office. To help you along, we'll not present answers – paraphrased or otherwise – this time around. If you can answer the questions presented here, you're certainly ready to tackle the real thing. If you can't answer them, it's time to go back to your book-cracking. Got your pencil ready?

NOVICE STUDY QUESTIONS

1. What is the maximum input power permitted to the final stage of the transmitter in a station licensed to the holder of a Novice Class license or operated by such an operator?
2. What is the maximum penalty for a violation of the rules and regulations of the Federal Communications Commission?
3. On what frequency bands may the holder of a Novice Class license operate an amateur radio station?
4. On what frequency bands may the holder of a Novice Class license operate an amateur radiotelephone station?
5. What is the log of an amateur station, and what information must it contain? How long must it be preserved?
6. For how long is an amateur Novice Class license valid and may it be renewed?
7. What are the rules and regulations regarding the transmission of improper language, false signals, or malicious interference?

8. What are the rules and regulations regarding purity and stability of emissions?

9. How must the transmitting frequency of a station licensed to the holder of a Novice Class license be controlled?

10. What are the rules and regulations regarding the measurement of the frequencies of the emissions of an amateur radio station?

11. Who may be permitted to operate the transmitter of an amateur radio station licensed to the holder of a Novice Class license?

12. When may an amateur radio station be used by a person who does not hold a valid license?

13. What is the maximum permissible percentage of modulation of an amateur radiotelephone station?

14. At what intervals must an amateur station be identified by the transmission of its call sign? May any transmission be made without identification of the station?

15. When is notice of portable or mobile operation required to be given, and to whom in each case?

16. What are the recognized abbreviations for: kilocycles, megacycles, Eastern Standard Time, Greenwich Mean Time, continuous wave, frequency modulation, amplitude modulation?

17. What is the relationship between a fundamental frequency and its second harmonic; its third harmonic; etc.?

18. What is the relationship between a cycle, a kilocycle, and a megacycle?

19. What instrument is used to measure: electrical potential; electrical current; electrical power; electrical energy?

20. What is the purpose of: a modulator; an amplifier; a rectifier; a filter?

21. What is meant by: amplification; modulation; detection; attenuation?

22. What is the purpose of: a radio-frequency choke; an audio-frequency choke; a filter choke?

23. How is the actual power input to the tube or tubes supplying energy to the antenna of an amateur transmitter determined?

24. Why is a rectifier and filter required in the plate power supply system of an amateur transmitter when operated from alternating current?

25. What is a frequency multiplier?

26. What are the undesirable effects of over-modulation in radiotelephony?

27. What is a "parasitic" oscillation?

28. What is a "key-click filter" and when should it be used?

29. What is Ohm's Law?

30. What is the relationship between the frequency and wavelength of a radio wave if its velocity in space is 300 million meters per second?

31. What symbol is used in the Amateur Rules to designate amplitude modulated telegraphy without the use of modulating audio frequency (on-off keying)?

32. What is the ruling regarding eligibility for re-examination?

33. What factors are commonly responsible for h armonic radiation and what practical means can be used to detect and correct such condition?

34. How are radio signals transmitted over great distances?

35. International radiocommunication by way of amateur stations is subject to what restriction(s)?

36. What functions do capacitors perform?

37. Why are height limitations placed on antenna structures for amateur stations?

38. What methods are available for determining whether the transmitter output frequency is within the authorized frequency band?

39. What is the most likely defect of a tube which has proper heater voltage at the tube socket, but which fails to warm up?

40. What precaution(s) can be taken to reduce the possiblity of shock hazard in electrical equipment?

41. The plate voltage to the final stage of an amateur transmitter is n ormally measured between what points in the circuit;

42. When is one way communication permissible?

43. What is a Hertz? kiloHertz? MegaHertz?

44. What are some correct ways to call and answer other amateur stations via telegraphy?

45. What are some common Q signals and what purposes do they serve? What do QRA, QRM, QRN, QRS, QRT mean when transmitted as questions via telegraphy?

46. What important functions do diodes perform?

47. What units are used to measure capacitance?

48. How are transistors made, used, and diagramed? What are some common transistor parameters?

49. Why is impedance matching necessary?

50. What is chirp and how can it be remedied in a c.w. transmitter?

GENERAL CLASS STUDY QUESTIONS

1. Questions based on Part 97 of the Commission's rules.
2. Of what use is a bleeder resistor in amateur equipment?
3. Define skin effect. How can this phenomena be minimized?
4. List some operating procedures which can be employed to minimize interference and congestion of the amateur bands.
5. Describe the operation and usage of a cathode follower.
6. How does frequency tolerance affect band edge operation?
7. What is impedance matching and why is it important?
8. How is the plate circuit efficiency of a vacuum tube determined?
9. What is amplitude modulation (AM)? How is the intelligence conveyed in an AM signal?
10. What is meant by the ripple frequency of an a. c. power supply voltage?
11. What is a third party agreement?
12. How does a zener diode operate and of what use is it in amateur equipment?
13. Define standing wave ratio (SWR). How can the SWR of a line be determined? How are the SWR of a line and its characteristic impedance related? Name some factors that affect the characteristic impedance of an air-insulated parallel-conductor transmission line.
14. What is meant by the maximum plate dissipation of a vacuum tube?
15. What is a decibel?
16. What is a harmonic? List ways of minimizing harmonic generation in frequency doublers, vacuum tube amplifiers, transmission lines, and antennas.
17. What is a crystal resonator?
18. How do electolytic capacitors operate and why are they widely used in power supply circuitry?
19. What symbols does the Commission use to designate how the main carrier of a signal is modulated?
20. What are some possible causes of excessive plate current in a Class C power amplifier?
21. List several characteristics of a vertical quarter-wavelength antenna.
22. What is TVI? How can it be remedied if the amateur station is at fault? If the TV receiver is at fault?
23. How can transistors be used in electronic equipment? What is the beta of a transistor? Compare the elements of a transistor to a vacuum tube's
24. What is meant by percentage of modulation? What is the maximum legal limit to which an amateur transmitter can be modulated?
25. Describe briefly how oscillators operate. What are the most common types of oscillators and how do they differ from each other?
26. Why is a center-tap return connection employed on the secondary of a transmitting tube's filament transformer?
27. Define OHM'S law. How does it relate to resistive and reactive impedance?
28. Describe ways of equalizing the reverse voltage drops across series connected silicon diodes.
29. What is the maximum legal d.c. power that can be delivered to the final amplifier of an amateur transmitter? How is this power determined?
30. Define instantaneous power, average power, sideband power, audio power, and peak envelope power. How is each related to the voltage and current that produced it? How is each related to the unmodulated carrier power?
31. What is meant by the bandwidth of a signal? Compare the maximum necessary bandwidth occupied by a cw signal, an SSB signal, a double sideband signal, and an ordinary voice signal.
32. What is neutralization and how does it contribute to proper amplifier operation? What procedure should be followed to properly neutralize an r.f. amplfiier?
33. What are the distinguishing features between series tuned and parallel tuned resonant circuits? How is the resonant frequency determined? Define the "Q" of a resonant circuit.
34. How does an a.c. power supply produce a d.c. voltage? Distinguish between a choke-input and a capacitor-input filter and compare their operating characteristics. What is dynamic regulation and how can it be improved? How do the output voltages of a full-wave center-tapped and a full-wave bridge rectifier compare?
35. How do resistors combine in parallel and in series to give total resistance? Capacitors? Inductors?
36. How does voltage division occur across series connected resistors? Capacitors? Inductors?
37. What does it mean to connect circuit elements in series? in parallel?
38. What is inductive reactance? Capacitive reactance? How is their value determined? How do like reactances combine in series? In parallel?

39. Describe the transmissions characteristics of the amateur bands below 30 Mc/s. List several propagation factors that influence signal transmission and reception in these bands.

40. List the basic stages of a conventional superheterodyne receiver and tell what function each stage performs.

41. How is the approximate length of a half-wave dipole related to its resonant frequency? Compare the operating characteristics of a half-wave dipole and a grounded antenna.

42. What do high- and low-pass constant-k filter circuits using balanced and unbalanced pi- and T-sections look like?

43. How can amateur equipment be protected from lightning discharge?

44. What are the basic stages of a single sideband (SSB) receiver and transmitter and what purpose does each serve?

45. List the three main classes of amplifier operation and explain the use for which each class is best suited.

46. What are "images" in a receiver?

47. What is meant by "flat-topping" of a single sideband signal and what are some possible causes of it?

48. What does grid current flow in a Class A amplifier indicate?

49. Briefly discuss how a multiband "trap" antenna operates.

50. How can the power input to the final amplifier of an SSB transmitter be determined?

51. Compare the operating features of the grounded grid and grounded cathode amplifiers.

52. How is the bandwidth of an FM signal related to the bandwidth of the modulating audio signal?

ADVANCED CLASS STUDY QUESTIONS

1. Questions based on part 97 of the Commission's Rules which governs the Amateur Radio Service.

2. What is meant by the Standing Wave Ratio (SWR) of a transmission line? What is a good indication that a high SWR is present on a transmission line? Where is the best point on a long transmission line to measure the SWR?

3. What methods are most commonly used to generate single sideband signals? Draw a block diagram of the filter method showing all essential stages. How can a low frequency SSB signal be converted to the desired transmitting frequency? On what frequencies do SSB transmissions become more difficult? List some of the advantages SSB proides over double sideband operation.

4. How do the voltage, current, and impedance behave along a transmission line with an SWR of 1?

5. What are harmonics? How can the generation of excessive harmonics be avoided? Which class of amplifier operation is most favorable to the generation of hamonics?

6. What factors affect the state of ionization of the atmosphere?

7. What types of emissions can be received with selectible sideband receivers?

8. The ratio of the peak envelope power to the average power in a SSB signal is primarily dependent on what factor?

9. How can receiver sensitivity and selectivity be improved?

10. How close to the edges of a certain amateur band can you safely operate a VFO c.w. transmitter if you are using a frequency meter having maximum possible error of 0.01 percent?

11. A transmission line that feeds an antenna has a power loss of 10dB. If 10 watts are delivered to the transmission line input, how much power is delivered to the antenna? List possible causes of power loss. How can the SWR of the line be made as low as possible?

12. How do parastic oscillations affect circuits? What can be done to prevent or eliminate parastics?

13. What is backwave radiation? How can it be eliminated?

14. Define maximum usable frequency.

15. A resistor, capacitor and inductor each have 100 ohms of resistance or reactance. What is the equivalent series impedance of these three elements? How would the addition of a reactive element to a purely resistive circuit affect the sum of the voltage drops around a closed loop in the circuit?

16. What do oscilloscope patterns showing 33%, and 75% modulated signals without distortion look like? Show trapezoidal and AM envelope patterns.

17. What are some common types of oscillators employed in amateur equipment? How can each be identified in circuit diagrams? What part does feedback play in these oscillators? What points in the circuits should be coupled to provide good feedback? What affect would a reactive load have on an oscillator's output frequency? What can the value of the d.c. voltage across an oscillator's grid-leak resistor reveal about the oscillator's performance?

18. Why is neutralization important in amplifiers? What points in an amplifier circuit should be coupled to provide good neutralization?

19. When is an amplifer operating Class A? Class B? Class C? In which amplifier stages of an amateur transceiver are these classes normally used?

20. What happens to even-order products in r.f. linear amplifiers?

21. What is the third party agreement? What countries have such agreements with the United States?

22. What are lissajous figures in oscilloscope operation? How are the lissajous loop patterns produced on the face of a scope related to the frequencies applied to the scope's plates?

23. How are bypass capacitors used? How should their impedance compare with the elements they shunt?

24. How can TVI caused by cross-modulation be remedied? Where in a TV receiver should a TVI filter be mounted to best reduce television interference?

25. How can SSB signals be amplified with little or no distortion?

26. A superheterodyne receiver having an intermediate frequency of 455 kc/s is to be adjusted to receive a signal on 3900 kc/s. What frequencies can the oscillator be set to, to give a beat signal at the intermediate frequency?

27. What factors affect the peak envelope power of a transmitter?

28. How does a full wave bridge rectifier operate? What does the schematic diagram of a full wave bridge rectifier circuit using solid state components look like?

29. When can a low pass filter be installed in a coaxial cable without causing a large power loss at the fundamental frequency?

30. What standard formula is used to determine the resonant frequency of an antenna? How can the resonant frequency of an antenna be increased? Decreased? Compare the center impedance characteristics of the inverted V, the half-wave dipole, and the folded dipole antennas.

31. A 70 ohm half wave antenna operating on a frequency of 7300 kc/s is to be matched to a 50 ohm transmission line. Calculate the characteristic impedance of a quarter wave matching section and the physical length of the antenna at the frequency given. What is the SWR between the antenna and transmission line without a matching section?

32. Power dissipation in what part of a transistor warrants careful observance of power ratings?

33. Define the shape factor and selectivity of a crystal lattice bandpass filter. How are the shape factor and the selectivity related?

34. Compare the pentode, tetrode, and triode for use in an r.f. amplifier stage. Give advantages and disadvantages of each.

35. What is meant by describing a radio wave as horizontally or vertically polarized? Which type is most suitable for sky and ground wave propagation? How should an antenna be mounted to best receive each of these types of radio waves?

36. Which amateur band is the most suitable for daytime communication over a distance of about 200 miles? What amateur frequencies between 7 and 148 Mc/s inclusive, are most affected by weather conditions?

37. Should a voltmeter have high or low internal circuit resistance? Explain .

38. A transformer with 115 volts applied across the primary terminals has a primary to secondary turns ratio of 10 to 1. If a 5 ohm load is connected to the transformer secondary, the reflected primary impedance is what? How much voltage appears across 1/2 of the turns of the primary? What factors determine whether or not a transformer having a center-tapped high voltage winding can be used in a bridge rectifier circuit?

39. What functions does a variable-mu tube perform in an r.f. amplifier stage of a receiver?

40. Compare transistors and tubes. What are the advantages and disadvantages of each?

41. How do noise limiters operate? Where should they be positioned in a receiver to be most effective?

42. How do inductors combine in series and in parallel? Capacitors in series and parallel? Resistors in series and parallel?

43. Define frequency deviation in FM transmissions.

44. How does the peak-envelope power (PEP) input of an amplifier used for cw compare to the PEP of an SSB amplifier when using the maximum legal d.c. power? During the application of the single-tone test to a linear amplifier, how does the average power input to the amplifier relate to the PEP produced?

45. What are the advantages and disadvantages of using the same antenna for receiving and transmitting?

46. What is the vacuum tube counterpart of a (1) grounded-base circuit; (2) grounded emitter circuit; (3) grounded collector circuit?

47. How does the sunspot cycle affect wave propagation? What are the best frequencies to use for day and night, short and long distance communications during the cycle?

48. How does automatic gain control operate? When can it be used for SSB operation? CW operation?

49. How should a linear amplifier be adjusted for linear operation?

50. How is the power output of a 100% modulated AM signal related to the carrier power?

51. Why does a type 6146 tube have 3 prongs connected to the cathode?

52. What parameters affect the directional pattern of a beam antenna?

53. What are some precautionary measures that should be taken before replacing faulty circuit elements?

54. Compare the operating characteristics of wirewound and carbon type resistors.

55. List ways of protecting amateur equipment from damage induced by electrical storms.

56. Define single and double conversion. What is an intermediate frequency (i.f.)? In a receiver, how does the image frequency relate to the desired signal frequency?

57. Explain why the grid wiring in an r.f. transmitter should be as far removed as possible from the plate circuitry.

58. What is a dummy antenna? How can it be of use to amateur operators?

59 What is meant by percentage of modulation? What determines if a carrier wave is under- or over-modulated?

60. What affect would a self-oscillating buffer stage have on a transmitter's output frequency?

61. What is meant by the "effective value" of a voltage? "Peak to peak value"?

62. What is a wave-trap? Draw some common wave-trap configurations.

63. What circuit condition is indicated by a high direct current reading in the grid meter in the final Class C amplifier stage of a transmitter?

64. Briefly discuss the advantages and disadvantages of using paper, mica, air, and ceramic type capacitors. What happens to a circuit when a capacitor develops a leakage resistance?

65. Discuss the characteristics of a series resonant circuit; a parallel resonant circuit.

EXTRA CLASS STUDY QUESTIONS

1. What are sideband frequencies? During 100% sinusoidal amplitude modulation, what percentage of the average power is in the sidebands? How is the sideband power related to the percentage of modulation?

2. Who do the modulation envelopes of amplitude-modulated waves with 75%, 100%, and greater than 100% modulation look like?

3. How may a limiter be employed in an FM receiver?

4. What precaution(s) should be taken when measuring the rectified grid voltage in an oscillater with a d.c. voltmeter?

5. What is meant by frequency shift keying and how is it accomplished?

6. Why is there a practical limit to the number of stages that can be cascaded to amplify a signal?

7. What are A5 and F5 emissions? On what amateur frequencies can be emissions be transmitted? Can A5 emission be transmitted satisfactorily using one sideband only?

8. How does amateur TVI usually affect television reception?

9. Describe briefly the basic sections of a single sideband (SSB) transmitter. In what section of a properly operating SSB transmitting system is distortion most liekly to originate? In what section is nonlinearity most likely to originate?

10. Define what is meant by the time constant in a resistance-capacitance circuit? How is the time constant determined?

11. How does a squelch circuit operate? Draw a commonly used squelch circuit.

12. An oscilloscope is used to study the relationship between the input and output of an amplifier produced by a voice signal. How would the scope pattern display a linear relationship between the input and output signals?

13. Draw a block diagram of an RTTY system showing the primary function of each stage. What is the proper way of identifying an RTTY transmission? What is the most widely used frequency difference between the mark and space frequencies in a conventional RTTY transmitter?

14. How can the two-tone test output of a linear amplifier be used to tell if a transmitter is working properly? Show scope patterns for optimum, overdriven, and underdriven amplifer conditions.

15. Define the alpha cut-off frequency of a transistor. How is this parameter of use in circuit design?

16. What are inductive and capactive reactance? How are their phase angles related? How does their reactance affect actual power dissipation in a circuit?

17. How does the positioning of a powdered iron tuning slug affect the frequency of the oscillator it is tuning?

18. Define the deviation ratio in a frequency modulated signal.

19. What type of signal will be produced when the output of a reactance modulator is coupled to a Hartley oscillator and multiplied in frequency?

20. How would the reception of a single sideband signal be affected if the carrier is not completely suppressed? How can spurious signals in the output of the mixer stage of an SSB transmitter be suppressed?

21. How does the best frequency oscillator affect the tuning of a single sideband signal?

22. Can a lossy transmission line be used to transmit signals? Explain.

23. How can you distinguish between a product and an envelope detector?

24. How can a receiver be adjusted for SSB reception when the receiver does not have a product detector?

25. How do mica and paper dielectric bypass capacitors compare at different frequencies?

26. Discuss the advantages and disadvantages of electrolytic versus paper filter capacitors.

27. Where in a receiver circuit should a limiter/blanker stage be placed to provide maximum utility?

28,What frequency should a crystal oscillator circuit be tuned to for maximum stability?

29. What are microwave frequencies? What type of oscillator is commonly used to generate microwaves?

30. What are some of the factors that affect the field strength of a signal from a radiated antenna?

31. What factors determine the frequency at which a quartz crystal will oscillate? List some of the advantages of using crystals in amateur equipment.

32. Explain the properties of a quarter-wave section of r.f.transmission line. How would these properties change if the output ends of the section were short-circuited?

33. How should a wave trap be connected to a receiving antenna circuit to attenuate an interfering signal?

34. Why are synchronizing pulses transmitted with television signals?

35. How may an amateur check his transmitter for spurious sidebands?

36. How can the safe power input to a crystal oscillar circuit be determined?

37. Define the term decibel. How is the decibel used for voltage and power calculations?

38. How are the emitter, base, and collector of a transistor biased for amplifier operation? How are they biased for cutoff (open circuit) and saturation (short circuit)?

39. How do N-P-N type transistors differ from the P-N-P type? How does their bias differ?

40. How can the output circuit of a transmitter be adjusted to increase or decrease its coupling to the antenna system?

41. How do filters attenuate harmonic emissions?

42. List several advantages and disadvantages each for Class A, Class B and Class C amplifier operation.

43. What are some different types of noise voltages encountered in amateur receivers? How is each type generated.

44. What are current and voltage characteristics along a transmission line when it is matched and mismatched?

45. How do receivers for remote control of objects and regular type communications receivers differ in basic operation?

46. What is the vacuum tube counterpart of a (1) grounded-base circuit; (2) grounded emitter circuit; (3) grounded collector circuit?

47. What useful functions does a balanced modulator perform in a radio transmitter?

48. How does the directivity of an unterminated "V" antenna and parasitic beam antenna compare?

49. If a crystal lattice bandpass filter has bandwidths of 3 kc/s at the 60 dB points and 1.5 kc/s at the 6 dB points, calculate the shape factor. At what frequency is the best shape factor achieved in a crystal lattice filter?

50. What would happen if the grid-bias supply of a Class C modulated amplifier was suddenly short-circuited?

51. How do trimmer and padder capacitors affect the low and high frequencies in receiver tuning?

52. What is the phase relation between the input and output signals in the common-emitter, common-base, and common-collector transistor circuits?

53. How can a transmitter be tested for self oscillation? What precautions should be observed during testing?

54. How can unwanted VHF resonances in a transmitter amplifier be moved from

TV channel frequencies?

55. A 70 ohm transmission line is connected to a 35 ohm antenna. Calculate the standing wave ratio (SWR), the reflection coefficient, and the percent reflected power. If 10 amperes are flowing in the antenna terminals, what is the current in a transmission line node? How is the SWR related to the forward and reverse current flow?

56. What is a grid-bias amplifier? Should the source of fixed bias have a high or low internal resistance? Explain.

57. Of what importance is the signal-to-noise ratio of a receiver? At what radio frequencies is this ratio most important?

58. What are Aurora-reflected VHF signals? If such a signal is heard, what does it sound like?

59. What is meant by percentage of modulation? What determines if a carrier wave is under- or over-modulated?

60. How does a cathode-ray tube operate? What magnitude of voltage is normally used to bias the plates of a cathode-ray tube? What purpose does this magnitude of bias voltage serve?

61. What are some causes of the excessive production of harmonics in r.f. amplifiers? How can these causes be remedied?

62. What effect does a transmission line which is not properly terminated have on the plate tank circuit of a transmitter?

63. How are reactance tubes used?

64. How do phasing condensers help stabilize cyrstal filter circuits?

65. What means may be employed to measure low frequencies? High frequencies? VHF and UHF?

66. How are grounded-grid amplifiers used in electronic circuits? List some advantages and disadvantages of their use. Describe the input impedance characteristics of a grounded-grid amplifier.

67. What constitutes a parasitic antenna element?

68. What is the image-response of a receiver? How can it be reduced?

69. What is a third party agreement? What countries have agreements with the United States?

70. What effect will extending the low-frequency audio response of a signal have on the design of an SSB transmitter?

71. List some different types of beam antennas.

72. What radiotelephone transmitter operating deficiencies may be indicated by a decreasing antenna r.f. current during

modulation of the final r.f. amplifier?

73. What improper operating conditions are indicated by the upward or downward fluctuation of a Class A amplifier's plate current when a signal voltage is applied to the grid? How can this be corrected?

74. What improper operating conditions are indicated by the upward or downward fluctuation of a Class A amplifer's plate current when a signal voltage is applied to the grid? How can this be corrected?

75.,What may be the cause of a decrease in antenna current during modulation of a Class B r.f. amplifier?

76. What determines the skip distance of radio waves?

77. How can parasitic oscillations be prevented?

78. Give some proven methods of harmonic reduction in transmitters.

79. Describe briefly some well known types of antennas and antenna systems used by amateurs which do, and do not, reduce harmonic radiation.

80. What must the value of an inductor be to cancel a capacitive reactance of 12.6 kilohms at an operating frequency of 2 Mc/s?

81. What is meant by "end effects" in an antenna? How can they be compensated for in half-wave antennas?

82. What are the bandwidths normally used for A1, A3 (single and double sideband), and F3 (narrowband) type emissions?

83. Describe briefly how an ac power supply produces a d.c. output voltage. Discuss the merits of using choke-input versus capacitor-input filters in power supplies. How does the leakage resistance of the capacitors affect the output voltage? Also, what is voltage regulation as related to power supplies?

84. Compare silicon and vacuum tube diodes. What is meant by the "forward voltage drop" of a conducting silicon diode?

85. What is push-pull amplifier operation?

86. For what purpose is a Q-multiplier used in amateur equipment? What major factors affect the Q of a coil? Of a circuit?

87. How can the final amplifier of a transmitter be tested for self-oscillation?

88. How does a frequency converter operate?

89. What visual observation within an operating vacuum tube's envelope would indicate that the tube is gaseous?

90. Questions based on Part 97 of the Commission's rules.

. . .Staff ■

(Letters continued from newspages)

I must agree with the people you castigate for their pressures, which you say killed the Swan-1011. It is indeed heartening to see outrage among the amateur consumer, the bread and butter of Swan Electronics. Reaction of consumers in other areas similar to this is sorely needed. I commend Swan for its decision to discontinue this equipment and exercising good judgment.

This was not written to knock Swan. That organization, if it is not the most respected name in its field, at least represents a high water mark. But let's not market CB equipment under the guise of amateur radio equipment. Call it what it is and give that segment of the market quality equipment as dependable and as legal as we now have. I do not find the concept of free enterprise and free marketing alien. But there is enough amateur radio equipment available already which can be put to improper use — why add more?

Thank you for your patience. Keep 73 as comprehensive and as thought-provoking as it is now. I am sure it will continue to grow both in eminence and in volume.

Mike WB8BOI,
1951 Burns Ypsilanti MI

73 is always happy to publicize all facets of every issue. My editorial expressed my true feelings, and without regard for the relative repercussions of readers and/or advertisers. Perhaps some of these letters have evened the odds a bit.

. . . Ken

Although I agree with both your and Swan's basic premise that an 11m monitor would be a good indication of 10m band openings, this could be done just as well with a single crystal-controlled CB receive channel that is busy enough to be useful, and yet it is of little or no interest to bootlegging CB'ers. Also, if Swan was not contemplating a CB market, why was the rig advertised in CB magazines? The three points brought out in your editorial are also rather faulty. First, any CB'er that would spend the money to buy the 1011 is probably capable of converting it or finding someone who can. Second, several CB'ers have been heard on 10m recently (an advance patrol checking out a new wide-open terri-

You apparently don't know much about the average CB'er. 'Not one CB'er in two hundred. . .' You ARE alseep! What would have been closer would have been: ". . .Would have any trouble finding those two wires going to the range switch back wafer". As to the CB'ers 'joining the hams on Ten': Not JOIN — but use Ten — when there were no hams on, late at night when all the hams are sacked out! As for the hams on CB: Yup; listen sometime. The guys on CB talk about their KWM-1s, and wKs all day long. Many of these guys have both ham and CB tickets, but use a code name instead. Lastly, as for the innocence of Swan: Why do they call it the 1011 rather than the 1050 or 310 or some such number more closely fitting their conventional nomenclature? Why is the dial so well calibrated for CB? Why is the ac supply and speaker built-in? Why are both sidebands provided for, when most hamband rigs provide only one per band? Why are the CB channels numbered rather than in MHz or kHz?? Ask yourself these questions if you haven't already, which is, to me, obvious. One thing abou. your 'lunatic ffinge': we're for the most part one jump ahead of you in the think department. And we seldom jump from opinion to opinion as the money interests dictate, in the manner of some of you non-lunatic types. Bravo. No, I'm all for the manufacture and sale of the Swan superpowered CB rig, because I nave spotted from the start just what the underlying purpos is behind the CB band: That is a

often tedious, thankless work? I personally knew a League director (one whom you unjustly criticized some years back). Even though we often disagreed on some of our ideas he was an honest, and hard working individual, truly dedicating his spare time in the interests of ham radio. His only operating was in occasional MARS work. You think it is a crime, apparently, to not be active on the air.

When an individual holds down a demanding job, raises a family, keeps his home in repair, works diligently to maintain a college ham station in spite of heavy, official pressure to abolish it, and takes an active interest in promoting the success of a college radio club in addition to his responsibilities as a League director, when is he *supposed* to find time to operate? This man, whom you so thoughtlessly critized, felt it his obligation as a League director to attend many clubs and hamfests in his jurisdiction where he was conspicuously found listening to the ideas and suggestions of his constituents. He often had to make long trips away from his family in the pursuance of his duties, to sit long and tedious hours at meetings at ARRL. The only money he received for those efforts was a partial payment of his gas money!

Even in your more innocuous articles you seem to have to throw shit in somewhere! A prime example appears on the news page. Are you people so stupid as to think no one uses code? Have you invented a new means of transmitting "smoke signaling, semaphore, drumbeating, and letter writing" via radio (other than by facsimile or ATV)? I think not! If I'm wrong, I dare you to print the mechanism in your next issue. (The FCC does not test the use of the English language or speech skills). To me, this little snide remark was thrown in by an angered, biased, bigoted individual who would, if he had his own way, abolish code entirely

My feeling is that a helter-skelter system of getting what the League calls a thorough reading of amateur sentiment should not be acceptable to League members. I have been involved in conducting advertising and consumer reaction surveys for years for a billion-dollar organization. I maintain that a uniform method must be adopted in order to come up with a meaningful reading. In the case of the League they let each director spin off on his own without uniform direction. Perhaps they wanted to make sure that the results would parallel their predetermined decision. Frankly, I feel certain that they had their minds made up before the survey was even conducted.

Al W4YHB,
Box 1909, Hendersonville NC

I have been progressively disillusioned with ARRL and QST, but not for the reasons you are. In fact, I am of the opinion that incentive licensing is one of the few good things they have promoted. QST has gone downhill in the past few years; in its senility it has run endless articles on the museum, the wouffhong, etc; club doings, manufactured gear, etc; with very little material for the amateur. I hope that 73 doesn't mind a little constructive criticism: I blew a whole buck the other day on my first 73 in years, hoping that your initial burst of vitriol at the League had burned itself out. It is one thing to stir up a controversy to build circulation, and quite another to keep harping away for years on viewpoints which are, in the final analysis, merely those of a couple of guys in New Hampshire and not divinely etched on tablets of stone. I refer, for example, to the article in the "News" wherein you report that the FCC refused to lower the code requirements for the extra class licenses, a development which I heartily concor. Your writer then has to add the somewhat asinine comment: "which

You got your nerve saying that Director Dannals hindered ham radio. I know him personally and like him, he was nominated and elected by a single petition which proves he's best for the job or is it 73's greed, because Harry wouldn't let you put your booth in the convention (Hudson). I see why you are against incentive licensing, because for every 2 Generals there's 1 Advanced and maybe 0.6 Extras. You can really appeal to the majority (Generals) in trying to boost your magazine overnight. You know as well as I do that Advanced with little studying is easy to obtain. I am 13 years old and have my Advanced ticket. You hold one yourself. As I close this letter I remind you to be a little less greedy and because a man (our director) refuses to let you in, you strike him down without reason but only to retaliate. If you think Harry is not worthy, prove it!

P.S. We did. See Mr. Virgo Himself editorial, December issue.

Bravo!!! I was tickled pink when I saw your notice on do-nothing-directorships. I support the ARRL but not all the people who claim to represent it. The director mentioned is certainly not one of my favorite hams. When I lived on Long Island I was not able to have a rig on the air. I had some important traffic to get out so I went to this fellow's house. He was very curt and told me he wouldn't be able to put this traffic on any net. Somehow, if he is unable to support public service how can be represent amateur radio? Why not take a close look at all ARRL officials when they come up for re-election? In particular, there must be a large number of SCM's (one I am acquainted with) who are not the best of all candidates for the job. Why do they get reelected? The standard answer is "They are nice guys from the good old days and they have been SCM for a long

of the illicit 10m operators have been apprehended is the same as the reason that few of the bootleggers that stay on the 23 CB channels are ever halted: they're not kind enough to use identification that the FCC can use to trace them! They don't have enough men to catch the mistakes of legal operators, much less deliberate violators that would have to be tracked down individually. Third, I know of many amateurs who would take extreme delight in loading up a high-power transmitter for a couple of hours on any CB channel. These inexcusable lids are the same type that willfully jam emergency traffic because they hate nets, and other nice things along the same lines.

The above did not prompt me to write this letter anywhere near as much as K6MVH's reference to the "lunatic fringe." One of the leaders of the anti-1011 movement was WA6KZI, the ARRL SCM for Los Angeles — one of the foremost fighters for reform within the ARRL's local structure. It was also backed by ARRL Director John Griggs, a ham whose bid for reelection is supported by 73 in the same issue in which your editorial appeared. In two fair-sized Southern California clubs, the Palisades and Inglewood ARCs, there were few, if any, members that thought the 1011 a good idea. Some of the Southland's most responsible amateurs are members of these two clubs. And these are well-informed men and women, not lunatics! I consider myself a 73 supporter, so I hope you take this letter as it is meant to be taken — as constructive criticism. It is a needed irritant that may someday bother the ARRL into something really constructive, as well as being an interesting experiment in the expression of free speech. However, I think that you should worry more about alienating your readers than losing one Radio Today advertiser.

Dan WA6FQC,
3630 Bentley, L.A. CA

spectrum for people too dumb to get a ham ticket, and with no real reason to have business-band, and it keeps the clods fairly well clear of both services. However, there *are* good CB'ers, that can hardly be denied. Yet the facts are that the reason self-policing doesn't work on CB is that all CB'ers have something to hide from their fellow CB'ers; so far be it from any one of them to crack down on 'The Bobcat' working skip on a restricted channel with a huge linear, because, why, they've got a linear hidden in the attic themselves!

So much for CB; I'm in favor of not only restoring the license structure so that a General Ticket will amount to something; we NEED a paid lobby in Washington. Whatever happened to the IoAR?I am largely in agreement with those who oppose the ARRL; I think the ARRL is a good example of a parasite killing the host. I still can't see how a nonprofit organization can have a stock portfolio!! The ARRL is phoney through and through, and the sooner all the hams find it out and act accordingly the better off we all will be.

Bill K9FOV,
424 Bomberding, Lafayette IN

DANNALS, THE LEAGUE, ETC.

I favor just and honest criticism (backed by documented fact with nothing conveniently left out solely to prove someone's emotional feelings), *not* the type you print. Much of what you print is often either misleading, not true, or exaggerated out of proportion. No damned wonder, Dannals wouldn't be in favor of allowing you in the convention. I will no longer allow you in my home after my subscription expires. Why not support amateur radio and all its many and diversified facets instead of trying to fragment and tear it apart? Which one of *you* is a League director? Why not? Is it because you don't make enough money from it? Is it because it is hard and from ham radio. It seems so to me for the simple reason that the statement was so ridiculously absurd and out of place. It is the boring repetition of such trite and inaccurate crap throughout your magazine that soon leads one to begin to doubt the veracity of *anything* you have to say, even if it may be true. Don't you see that if you had legitimate beefs about things, and commented truthfully about them without twisted falsehoods, half-truths, and asinine statements, people would not then begin to doubt your veracity? Your attitude on CW is reminiscent of the childish AM vs SSB arguments which used to plague our phone bands!

Steve Conn
412 Palstead, Westfield NJ

It is possible to express opinions without being vulgar, you know.

. . . Ken

For a number of years I felt that much of the criticism aimed at the League was not justified, but I have changed my mind. It took only two letters to the League to realize what a shallow-minded group of so-called executives are heading up the activities that are of grave important to amateurs around the world.

Why have I changed my attitude? Back in September I wrote a letter to the League on the "It Seems to Us" column, September issue. I specifically challenged a statement which was in response to this question: "Why, then did the League's board reject expansion (of the U.S. phone bands)? Answer: "because a *thorough* reading of amateur sentiment showed no widespread desire for affirmative action." Then they continue ". .. at the board meeting, directors reported on sentiment within their divisions. Some had taken direct mail polls of membership opinion; some only samplings; some relied on club councel and similar organizational channels."

leads one to wonder why the FCC does not require today's amateurs to be skilled in SUCH OTHER UNRELATED COMMUNICATIONS media as smoke signalling, semaphore, drum-beating, and letter writing." Aside from the ill-manners involved in injecting editorial bias into news articles, the writer of your article should know that there is no media of communication totally unrelated to any other. The requirement that the Extra class be proficient in code is a good one. Anyone who has heard the "voice-only" (disk-jockey type ham) struggle to maintain communications when signals are weak, and then compared it to the real communicator who uses the key to find a clear channel, will realize that CW has definite uses, even in the phone band. If your goal is to crease disk-jockey hams, with their manufactured rigs, cute phonetics, etc., then technical knowledge and code requirements are superfluous.

I have been looking for a mag rich in technical material. I had hoped that 73 would forget the politics and Wayne Green editorials, but such is not the case. Those of us who travel for a living find Wayne's adventures very unimpressive, and it seems the waste of a dollar to read such editorials as in the November issue — something about Women's Lib — I never did finish it.

You people at 73 seem so very, very opinionated! You are so certain that what you say is the ultimate, final word; you blast out at those who disagree with you in such a shrill manner as to discourage all discussion. You are taking all the fun out of ham radio. I note most of the letters you print are those bearing orchids, so doubt if this will see the light of day.

Ben W7FNE,
Box 103, Tolovana Pk OR

Didn't the editorial make you stop and think?

. . . Ken and Wayne

time." That's a pretty sick reason to elect a fellow to office. Don't vote unless you know the candidates. Why put in someone who will give you only mediocre representation? I really hate to see these people consistently abuse their position by exerting influence in the name of the ARRL. I am sure one SCM I know "rewards" his friends for their support in all sorts of ways, such as making strong suggestions towards their receiving "amateur-of-the-year" awards. This is an endless list of misdoings and I won't belabor the point.

I don't mean to sound like sour grapes on the subject of the ARRL. I have applied for life membership (same with 73). I only hope that those people who represent Newington are the best possible people for the job.

Bob Harper W1FKP

I'm enough of a prude to not enjoy hearing most four letter words used on the air, except a heartfelt damn or hell. What I call obscene is a picture of the napalming of jungle villagers, or the wasted bodies of African children being systematically starved; or the murder of a man, be he a president or a villager defending his right to live. That is an obscenity charge which has substance, since the purveyors are doing it for money. The obscenities of the ham fraternity, by comparison, are small boys experimenting with the language. They outgrow it, or the FCC monitors can be alerted.

A "heated discussion" on politics, sex, or religion can't be condemned either, since many ideas are born in the telling and if there is one thing this country needs, it is ideas, good, bad and in-between. If I can make someone think, I may make him unhappy and I suppose this is bad. But I'm unconvinced that it is.

Jack Weatherly K1ZYG
473 Auburn St.,
Auburndale MA 02166

PROPAGATION CHART
J. H. Nelson
Good O Fair (open) Poor□

January 1971

SUN	MON	TUES	WED	THUR	FRI	SAT
					1	2
3	4	$\boxed{5}$	$\boxed{6}$	7	8	9
10	$\boxed{11}$	$\boxed{12}$	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	$\boxed{30}$
31						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	7	7	7	7	7	14	21	21	21
ARGENTINA	14	7	7	7	7	7	14A	21	21	21	21A	21
AUSTRALIA	21	14	7B	7B	7	7	7B	14B	14A	21	21	21
CANAL ZONE	14	7A	7	7	7	7	14	21	21A	21A	21A	21
ENGLAND	7	7	7	7	7	7B	14	21A	21	14	7B	7
HAWAII	21	14	7B	7	7	7	7	7B	14	21	21A	21A
INDIA	7	7	7B	7B	7B	7B	14	14	14B	7B	7B	7
JAPAN	14	7B	7B	7B	7	7	7	7B	7B	7B	7B	14
MEXICO	14	7A	7	7	7	7	7	14A	21	21A	21A	21
PHILIPPINES	14	7B	7B	7B	7B	7B	7	7	7B	7B	7B	7B
PUERTO RICO	14	7	7	7	7	7	14	21	21	21	21	14
SOUTH AFRICA	14	7B	7	7	7B	14	21	21	21A	21	21	14
U. S. S. R.	7	7	7	7	7	7B	14	21	14	7B	7B	7
WEST COAST	21	14	7	7	7	7	7	14	21	21A	21A	21

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7	14	21	21	21A
ARGENTINA	21	14	7	7	7	7	14	21	21	21	21A	21A
AUSTRALIA	21	14	7B	7B	7	7	7	7B	14A	21	21	21
CANAL ZONE	21	14	7	7	7	7	14	21	21A	21A	21A	21A
ENGLAND	7	7	7	7	7	7	7B	14A	21	14	7B	7B
HAWAII	21	14	7B	7	7	7	7	7	14	21	21A	21A
INDIA	7	7	7B	7B	7B	7B	7B	7	7B	7B	7B	7B
JAPAN	21	14	7B	7B	7	7	7	7	7	7B	7B	14A
MEXICO	14	7	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	7B	7B	7B	7B	7	7	7	7B	7B	14
PUERTO RICO	14	7A	7	7	7	7	14	21	21A	21A	21A	21
SOUTH AFRICA	14	7B	7	7	7B	7B	14	21	21A	21	21	21
U. S. S. R.	7	7	7	7	7	7B	7B	14	14	7B	7B	7B

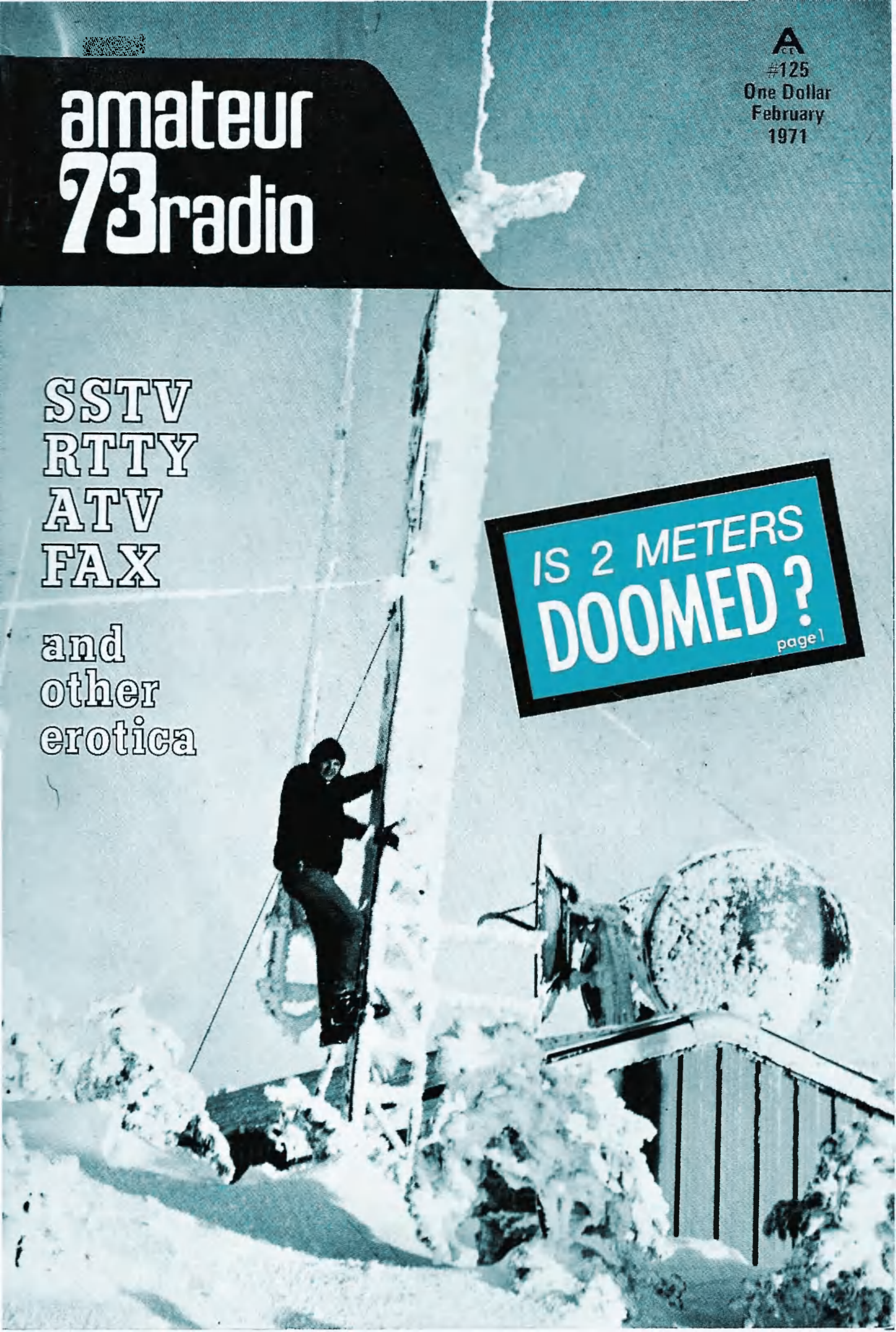
WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	3A	3A	7	7	3A	7	14	21	21
ARGENTINA	21	14	14	7	7	7	7B	14	21	21	21A	21A
AUSTRALIA	21A	21	21	7B	7	7	7	7B	14	21	21	21
CANAL ZONE	21	14	7	7	7	7	7	14	21A	21A	21A	21A
ENGLAND	7B	7	7	7	7	7	7B	7B	14A	14	7B	7B
HAWAII	21A	21	14	7	7	7	7	7	14	21	21A	21A
INDIA	7B	14	7B	7B	7B	7B	7B	7	7	7B	7B	7B
JAPAN	21	14	7B	7B	7	7	7	7	7	7B	7B	14A
MEXICO	21	14	7	7	7	7	7	14	21	21A	21A	21
PHILIPPINES	21A	21	7B	7B	7B	7B	7	7	7	7	7B	14A
PUERTO RICO	21	14	7	7	7	7	7	14	21A	21A	21A	21
SOUTH AFRICA	14	14B	7	7	7B	7B	7B	14	21	21A	21	21
U. S. S. R.	7B	7	7	7	7	7B	7B	7B	14	7B	7B	7B
EAST COAST	21	14	7	7	7	7	7	14	21	21A	21A	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

amateur 73 radio

#125
One Dollar
February
1971



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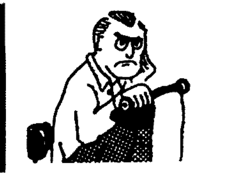

. . . de W2NSD/1

NEVER SAY DIE

The most serious attempt ever mounted against the 2 meter band recently took place.

Industry insiders intimate that this scheme was cooked up by the publisher of S9 (also publishes CQ) magazine. Since this was virtually admitted in a recent CQ editorial there seems little reason to doubt the reports.

S9, which has proposed such gems as sending empty beer cans to senators to impress them with the importance of CB, apparently has been feeling a need for more circulation and promoted the idea of throwing the amateurs out of half of the 2 meter band and turning it over exclusively to the CB gang. More manufacturers than you might think went along with this plan and it was backed by the most powerful CB industry group in the country.

This was not a plan for developing more amateurs, but purely and simply a scheme for selling more CB sets and more CB subscriptions.

It wasn't long before Galaxy had started turning out a nice little FM unit and two or three others were being imported from Japan. By 1970 this turned to a rush, as virtually every ham equipment manufacturer entered the FM market. None of these companies were doing this for fun – all this gear was being produced because amateurs were turning to 2m FM by the thousands.

Much has been written about this totally new type of ham operation, so that won't be rehashed here. The development of FM nets, the erection of hundreds of repeaters, and the fascination of this new type of operation started the biggest move to a new mode since the sideband revolution in the mid-50s.

Virtually all of this FM activity is taking place in the 146–147 MHz segment of the 2m band. Though there are perhaps 20,000 active FM'ers in this band at present, there is still plenty of room for five times that number . . . or more . . . before crowding may become a serious problem. Oh, there are many problems due to too many repeaters being on one channel or too few being tone operated, but only a few of the many channels in this segment of the band have been used in any area and lots more wait unused.

When one considers the extent of the disaster that might come about if this baud were taken away from the amateurs and turned over to CB, one wonders what possibly could have been going through the minds that cooked up the plan to do away with a good part of 2m. The expansion of FM on 2m may well be one of the best things that has ever happened to amateur radio. The emergency uses of this service are almost unlimited and could well do away with lower frequency nets. Think of the CD possibilities when low-powered hand transceivers can, through repeaters, be used just about anywhere. They can talk with each other through the repeaters, or be relayed on lower bands to anywhere in the world.

The systems being developed on 2m today will probably be used when amateur satellites and moon relay stations are an ordinary fact of life.

Fortunately, news of the attempt to emasculate 2 meters leaked out at the last minute and, hopefully, the effort was stopped – at least temporarily.

The proposal for the 220 MHz hobby class amateur license took a lot of the steam out of the push to take away 2 meters. Indeed, this may have been the deciding factor that kept the 2 meter proposal from being made.

Write to the publisher of S9 and CQ and tell him what you think of the plan to chop up two meters. Do what you can to stop this once and for all. Silence on your part means that you either agree that two should be given away or that you don't care.

The 2 meter band was opened in early 1946, just after the end of World War II, when the old 2½ meter band was taken away. 2½ meters was the first amateur band returned after the war, but the many radar (SD radar) and other units using the band during wartime were still around and the amateur band had to be moved up to 144MHz from 112 MHz.

By late 1946 this band was in heavy use with simple modulated oscillators and superregenerative receivers. As more and more military surplus was released, crystal control became the order of the day. By the early 1950s SCR-522s, ARC-1s, and several other surplus sets were just about every-

THE WORLD OF FM

Editorial by **Ken Sessions K6MVH**

Repeater Proposal RM-1725

The FCC now has before it a petition for repeater rulemaking that should go a long way toward pleasing everyone. When one repeater group proposed mandatory tones a long time back, lots of other repeater groups screamed bloody murder – they didn't want to be tied down to restrictions that clearly weren't necessary in their rural areas. When another repeater group, even earlier, proposed that automatic relay stations be allowed to operate without a continuous monitor on the UHF control frequency, the ting. That's life.

One very effective method for separating the sheep from the goats is through the use of access tones. Now, a repeater user must transmit a specific tone before the repeater will respond to his transmissions. And if gibberish starts coming through the repeater – or foul language, or interference, or general abuse – the transmitting station will have no out. He can no longer claim innocence because *he had to transmit that initial tone that would cause him to be repeated.*

Clearly, the responsibility for a re- .34/.94 as well as other combinations, why not just expand? If there is already a repeater within your range that's using the .34 frequency as an input, forget it! Be the first in your area to use .16/.76.

There's a great deal to be said for .16/.76. Not only is it a standard frequency pair separated by the standard 600 kHz spacing, but it allows the repeater users to get a little something extra when they crystal up their transceivers. They'll already have .94 direct and .34/.94 if they've bought one of the more popular of the new units

CONTENTS

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Phone: 603-924-3873. We want you to know that we here at 73 do not mind in the least if you are ingrates and subscribe to other ham magazines. We don't mind if you effectively stab us in the back by supporting our competitors. All is love and light in the ham publishing industry and we all feel that every amateur should subscribe to all four ham magazines. We all feel that way except us . . . we don't feel that way.

where. Then came the day of the Gonset Communicator . . . the Goony Boxes . . . they were everywhere, by the thousands. Never had a piece of ham gear been as popular as this little transceiver. By the mid-50s there were over 10,000 active 2 meter ops!

The opening of the band to the Technician and Novice licensees did in no way slow down the activity on 2 meters. But the opening of 6 meters did. The techs rushed to 6 meters almost *en masse* and, armed with Heathkit Lunchboxes, 6 meter Goony Boxes, and a sprinkling of Clegg gear, they proliferated. And 2m began to fade away.

Gonset brought out the Sidewinder for 2 meters . . . it fell on its face. Never more than a handful of pioneers made the sideband scene on two. The incompatibility of the SSB gear with communicators further disrupted the band, giving both groups fewer people to contact.

Up above 146 MHz there was something beginning to grow . . . FM. At first there were a few hardy ops that set up shop, and found only a few others to talk with. The AM and SSB groups couldn't break in and talk with the FM boys, so they kept up their life in the lower part of the band and ignored the FM'ers.

Next, the FCC shoved the Novices off 2 meter phone and the 145–146 MHz segment of the band really became deserted much of the time. The seasoned oldtimers still chatted down along the low end of the band, but they never listened for the Techs or Novices anyway. This was true in most of the country, with the southern California area probably being the only real exception.

At this time great quantities of commercial wideband FM gear became available which tuned to 2 meters. The rush to FM was on in earnest. Rule changes for the commercial services obsoleted thousands of units and they swiftly fell into amateur hands at a fraction of their commercial prices.

That brings us up to about 1968. As the commercial gear supply dried up and used gear began to disappear from the surplus ads in the ham magazines, manufacturers and importers began to take a closer look at the ham market. FCC winced. They weren't about to turn a bunch of unmonitored stations loose on the ham bands – such a method of operation was unprecedented in the amateur service for one thing; and for another, who would be held responsible when things weren't going according to the book?

This new petition, officially labeled RM-1725, could be the first step toward sensible legislation involving repeaters. In essence, the proposed rule says that those who use repeaters should be responsible for what goes out on the repeater transmit frequency – provided that those users have a means for commanding the repeater to be actuated (as with tone access).

Put differently, toned repeaters would not be required to be monitored by a fixed-control-point licensee who mans the UHF control rig. Repeaters that remain carrier-operated would still be required to have a continuous UHF control licensee monitoring at all times the repeater is in use.

Basis for Reasoning. At first glance, the petition might sound prejudicial to toned repeaters. But this ain't the case at all. Here's why: Take the case of a purely carrier-operated repeater, for example. Any station that happens across the repeater input frequency – whether he be AM, CW, TV, RTTY, or what-have-you – gets repeated. If the station is not FM, all that comes out of the repeater is garbage. Who should be responsible for tying a chunk of spectrum up for long periods and dominating an otherwise useful repeater channel . . . the repeater owner? Or the fellow who's transmitting the teletype on the input frequency? It's something of a moot question. If the fellow transmitting the teletype claims innocence in that he was transmitting without knowledge of the fact that he was being repeated, what could you say? And if the interfering station's transmissions weren't legal for any reason, should the repeater owner be held accountable? Remember, if the input station is making illegal transmissions, the repeater is making illegal transmissions. If someone uses your station to transmit dirty words, your station is liable to the same extent that the amateur is who does the transmit- peater's output can logically be placed where it belongs – in the hands of the users. But to carry out an *overall* sense of responsibility, the repeater should be designed with sufficient safety features to show the FCC that when things begin to go awry, the users themselves can initiate commands that cause the repeater to shut down. A timer on the transmitter B-plus relay, for example, should shut down the repeater when a transmission exceeds 3 minutes. Then, if the carrier-operated relay gets stuck down (intentionally or on purpose), or if something goes wrong with the repeater control circuitry, the whole system will turn itself off automatically. A user noticing an illegal transmission need but transmit a continuous signal for 3 minutes to shut things off.

A 5-second timer connected to the repeater's tone decoder could likewise cause shutdown in the event that the repeater's output deviates from the rules. Thus, any of the tone-equipped user stations could assert temporary but effective control over the repeater until the prime licensee could be notified and repairs begun.

You can't make much of a case for no-monitor operation of untoned repeaters, though. Someone *has* to be responsible for what's happening. And if the station being repeated can beg ignorance of the existence of a repeater, how could he logically be held accountable for what happens on its output?

So RM-1725 is a proposal that says toned repeaters need not be monitored and that simple carrier-operated systems *should* be. The proposal seems very sound to me. And well it should, since I am the one who initiated the proposal in the first place.

Coordination of Repeater Frequencies

Part of the source of problems in a number of portions of the country stems from the overeager clambering for a repeater that operates on the .34/.94 pair. It's nice to have repeaters on .34/.94, because you can travel here and there and be assured of some degree of standardization. But today .34/.94 is overpopulated. And, since most modern transceivers come equipped with enough channels to give you available to the amateur. When they add the .16/.76 pair, they'll also have the capability of crosswiring the .34 transmit crystal and the .76 receive crystal to a fourth position on the frequency switch so they can work through any of the many southeast and upper midwest machines that use the .34/.76 combination. At least give it some thought.

I am in a pretty fair position here at 73 to be of considerable help if your group or any other needs advice with respect to frequency coordination. Inasmuch as 73 publishes a periodic repeater directory, I am one of the first to be informed of new repeaters going up. So if you want to install a repeater, why not check with me to see what other frequencies are in use in your area; chances are I'll have accurate and up-to-date information. You're under no obligation to follow my suggestions, of course, but I can steer you clear of frequencies that might interfere with repeaters that are already under way. And if there is a trend toward a certain pair of frequencies in your area of the country, I can let you know those trends so you can make your repeater compatible with those. Such compatibility does enhance the usefulness of repeaters.

When you let me know of your intent to put up a repeater, I can mail you a list of the repeaters that are within a couple of hundred miles of you. And if you don't like the pair of frequencies I pick for you, you would at least be in a position to choose your own based on what's happening on the spectrum in question.

Things to Come

I'm no prophet, but I'll bet I can predict the future of certain aspects of the VHF FM world. Look for CQ to claim it is responsible for getting amateur FM started big. Look for the ARRL to put up an official *League Repeater*. Look for lots and lots of FM articles in all the ham magazines from now on. And look for an onslaught of new FM transceivers at better and better prices. Look for the ex-publisher of FM to make another try. And look for new names in the field of manufacturing of equipment designed to complement existing FM stations.

HAM USES REPEATER FOR THREATS, PROFANITY

LOSES OPERATOR PRIVILEGES

By an FCC order, Armond J. Rolle was directed to show cause why the license for radio station W9FCE should not be revoked for misconduct on the air. The order called upon the licensee to appear and give evidence in respect thereto at a hearing. By a second order, Rolle's amateur Technician class operator license was suspended for the balance of the license term pursuant to the Communications Act of 1934, subject to his right to request a hearing on the matter. Rolle did request the hearing, which was held in East St. Louis, Illinois, on September 15, 1970, on which date the record was closed.

Each of the said orders recites that Armond J. Rolle was charged with and convicted of criminal defamation for having communicated (by amateur radio) certain statements which concerned the character of a named person and by making threats of personal harm so as to provoke a breach of the peace; and that at various times since then transmitted communications of a threatening, abusive, and indecent nature.

The proposed station license revocation was based on recitals stating that the Commission would be warranted in refusing a grant of a license were the original application now before it and that the actions described are contrary to the public interest, convenience, and necessity standards of Sections 301 and 307(a) of the Act. The operator's license revocation was based on a recital that the actions described were contrary to the public interest, convenience, and necessity. Rolle's license was therefore suspended.

Evidence

The Bureau presented authenticated documents relating to respondent's conviction on criminal charges and a transcript of taped transmissions by respondent. Rolle testified in his own behalf, denying the authenticity of the statements attributed to him, but at the conclusion of which his counsel made a conciliatory statement. Rolle himself suggested a suspension of his operator's license until November 1, 1971, but without revocation of the station license.

One La Busier, an amateur licensee and holder of a technician class amateur license threatening language over the air. Rolle had been unable to use the repeater station of the St. Louis Repeater Club on occasions because people told him to get off the air; he had been "cussed at"; had music played; and otherwise harassed. He once reported such violations to the FCC; a field representative came to St. Louis in March 1969 and talked to him about it, but so far as he knows, nothing was done about it.

Rolle wrote the apologetic letter to La Busier when he had a serious operation and was under sedation and immobilized for 10 days. His purpose was to apologize for having called La Busier a "dirty rat" when the latter "interfered with" and "jammed" a transmission he was making. He said he had no intent to harm anyone and did not refer to Mrs. La Busier in the terms indicated in the tape transcript. He was "drinking badly" due to intense pain in his legs for which the operation was later performed, but he "does not drink now, due to ulcers." His criminal conviction for alleged acts on a day when his transmitter was being repaired, according to Rolle, came about because when he testified in court in his own behalf he was under heavy sedation and his counsel would not let him bring out the "whole details."

Rolle specifically acknowledged portions of the transcript while disclaiming others. He "guessed" however, that anyone in a "drunk" might do things he can't later recall and he could not swear that he could not have said these things while drunk. He also accused other amateurs of using his call signal because he overheard discussions of splicing and splitting tapes, but did not know who was impersonating him. He also alleged there was a "personal grudge" between himself, La Busier, and one other named amateur. He acknowledged the conversation with his aunt, Mrs. Stolle, but denied some of the specific statements.

Rolle himself maintained continuous tape surveillance of the assigned band but lost the tapes when his barn burned. While he has station logs for the period in question, he did not produce them.

Finally, the record disclosed he was indulging in "heavy sedation and alcohol" during the "abuse" period. Respondent's proposed findings also allege that his conduct has been above reproach since then, but this is contrary to the record, there having been two instances of defamatory remarks subsequent to that date. Rolle proposed a one-year suspension of his operator's license, and that the station license not be revoked.

Despite an apparent conclusive record, there being no dispute as to the facts, and the inexcusable and reprehensible nature of respondent's transgressions, there remained a troublesome question for disposition. The Bureau inexplicably relied solely on the broad standards of Sections 301 and 307(a) of the Act and completely ignored the provisions of Sections 303 and 312 which spell out the specific reasons for revocation or suspensions and the manner in which accomplished. The only conclusion offered by the Bureau related to those sections, is the statement which, though not so identified, is found in Section 312(a)(2):

"Also, as charged, it is concluded that these actions would warrant the Commission in refusing to grant an application filed by Respondent for an Amateur radio license if the original application were now before it."

The Bureau offered nothing, however, to relate Rolle's actions to statute, regulation, or Commission precedent, to sustain its conclusion. Section 301 provides for the licensing of radio channels but contains no reference to public interest or other standard; Section 307(a) provides for the grant of station licenses "if public convenience, interest, or necessity will be served thereby." This, of course, is a standard *for granting rather than for revoking* or denying.

The Bureau concluded that the Commission would be warranted in refusing to grant an application filed by Rolle if the original application were now before it, and, if so, this would justify the proposed action under Section 312(a)(2). But the Bureau makes this as a mere assertion without citation to statute, regulation, or precedent. While Section 308(b) authorizes the Commission to prescribe qualifications as to "citizenship,

HAM RADIO FOR CRIME NOT ILLEGAL

FCC Examiner Finds Loophole In Regs

FCC Hearing Examiner Fred Denniston, in reviewing a case before the Commission, came to the shocking conclusion that it is not unlawful to use ham radio for criminal purposes. "There is no direct prohibition," he said, "against the use of amateur radio for criminal purposes."

His finding noted that the CB regulations (Part 95 of the Commission's Rules) prohibits use "for any purpose, or in connection with any activity, which is contrary to Federal, State, or local law."

The flaw in the ham portion of the rules was noted while Examiner Denniston was reviewing the suspension order of Armond Rolle, an amateur who allegedly committed criminal acts on the air.

NO-MONITOR REPEATER OPERATION PROPOSED

Washington, D.C.s, The FCC is now considering a proposal to suspend monitoring requirements for repeaters that are tone controlled from the frequency of actual operation. The existing Rules require the licensed control amateur operator to monitor *from the fixed control point* at all times the repeater is in use (or available for use). The new proposed rule (RM-1725) would shift the responsibility to the stations who actually use the repeater.

Fixed-control-point monitoring has been the traditional requirement so that the repeater's operation could be suspended at any time its emissions deviated from the amateur rules of Part 97. Without tone control, there is no assurance that a repeater user is using the repeater intentionally; thus, if the emissions were not as required, there might be no means of shutting down the repeater unless the licensed control amateur is monitoring actively.

With tone control, however, the repeater can only be used when the user station

U.S. FAVORS BAN ON IMPORTS IF EXPORT NATIONS BAR U.S.

Newsweek Survey Shows One-Third Believe Quality of American Goods Declined Over Decade, But U.S. Products Still Get Highest Confidence

New York More than four Americans in five favor keeping foreign-made goods out of the U.S. if overseas nations bar the importation of American products. And three out of four believe the American public should buy "made in U.S." products because the increased buying of imports is causing unemployment. These are some of the findings of a survey of consumer attitudes released today by the marketing department of Newsweek magazine.

The survey, "Public Attitudes Toward Imported Products in the U.S. Market," was conducted for Newsweek by National Family Opinion, Inc. The study shows that despite their strong, outwardly protectionist views, the overwhelming majority of Americans still support the principles of a free market system. Two-thirds of the national sample – and three-fourths of a special high-income segment – agree that people *should buy products of the highest quality at the lower price no matter where they are made.*

In reviewing the findings, Newsweek Marketing Director Andrew Cullen noted that in designing the study, the trend of protectionist feeling among Americans was anticipated and, therefore, questions on the subject were included in the questionnaire. "They reflect no advocacy by Newsweek but rather are an attempt, at the request of a number of manufacturers and their advertising agencies, to assay the dimensions of this feeling," he said.

The sample in the poll consisted of 3,000 panel families which included an over sample of 500 families with annual income of $15,000 or more. Response rate from the combined samples was 75.6%. The purpose of the oversample was to determine if high-income families have attitudes toward imported products that differ from the population as a whole.

In the area of product quality, the Newsweek study shows that of four major industrial nations mentioned – three foreign

for about 10 years, has known Rolle for about the same length of time and has exchanged communications with him. At times, these communications were normal, but at others Rolle was transmitting foul and obscene statements concerning La Busier, his wife and child, other amateurs, and threats to people. Accordingly, La Busier made tape recordings, talked to law enforcement officers, and filed the criminal charges on which Rolle was convicted. La Busier also introduced a handwritten letter, dated October 29, 1969, which he had received from Rolle. The letter, written in advance of a serious operation which he was about to undergo, may generally be described as a confession of improper conduct toward La Busier and other ham operators, and a request for forgiveness.

Mrs. La Busier, also an amateur, identified various portions of the transcript of which she had made the taping, or had personally heard at the time, identifying the voice of W9FCE as that of Rolle's. Mrs. La Busier was the subject of the defamatory remarks which led to Rolle's conviction, and on other occasions as well, including threats of bodily harm. The provocative nature of these remarks is indicated by the transcript of December 16, 1968, when Mrs. La Busier, in retaliation, threatened to "blow that beady little head of yours (Rolle's) right off your shoulders."

Mrs. Stolle, an aunt of Rolle's identified a portion of the transcript where she remonstrated with Rolle on December 16, 1968, in a transmission from the La Busier station, for statements he had been making and in which he described himself as "dead drunk." She further confirmed threats which Rolle had made to "get" or "do harm" to La Busier, his family, and others if he should have his license revoked – specifically that he would bomb their houses.

Mrs. Familton, another amateur, described a number of transmissions by Rolle, whose voice she recognized, of the same nature as those in the FCC exhibit, and independently verified several of the instances in that transcript, including threats against the lives of herself and other members of the St. Louis Repeater Club. She also described an instance in March 1970, when she personally met Rolle and he apologized for the things he had said, explaining that he had been under a considerable strain and not feeling well. She also described an instance before Rolle's conviction in December 1969, when, after she had made a test call, Rolle came on and characterized her as a "fat old whore." Again, while her family was on an automobile trip during which her four children became boisterous, her husband made a transmission from their mobile unit, at the conclusion of which Rolle came on and characterized the children as a "bunch of bastards." The St. Louis Repeater Club, of which she is secretary, had expelled Rolle from membership because of his conduct on the air.

Rolle's Defense

Rolle, testifying in his own behalf, categorically denied making any such transmissions, or that he had ever used obscene or

Findings of Fact

Rolle, using station W9FCE, did make the transmissions which served as the basis of the show cause order. The statements include transmissions which Rolle himself conceded to be obscene; much profanity, defamatory statements of the nature on which he was prosecuted; and threatening statements of the following nature:

"... I said I woulda run into both cars today when you were at that house only thing I didn't want to hurt Harold Weiss. Luckily, he was standing there or I woulda hurt a whole bunch of other people. That was my intention."

"... She see me on the street, I don't run cause I carry a .25 automatic on me at all times. And I know how to use it. ..."

"Stupid, got something to tell you. You're gonna have an accident between Godrey and MacDonald coming home some evening here – some way, somehow. But you're gonna have an accident and it's gonna be fatal."

"... I ever see any of youse in person, I'm gonna blow your damn heads off. ..."

"... You people ain't fit to live, and by golly, you won't much longer."

These statements (all from FCC staff Exhibit 2) are against a background of Mr. Rolle's formidable appearance, which is described in the record as "unusually large in height and weight." Rolle is described as being 6 ft 11 in. tall and weighing in excess of 400 pounds, which is compatible with the observations of the hearing examiner.

Conclusions

The Bureau concluded that respondent's actions are not consistent with the purposes for which amateur radio is intended and are clearly, as charged, contrary to the public interest, convenience, and necessity. Also, as charged, it was concluded that these actions would warrant the Commission in refusing to grant an application filed by respondent for an amateur radio license. With respect to respondent's plea for clemency, the Bureau contended that due to the complete lack of candor exhibited through denial and subsequent admission of the matters charged, the defense of effects of drugs and alcohol is not a mitigation of the offense. Pointing to the heinous nature of the transmissions, the Bureau urged the imposition of the most severe sanctions available – revocation of the station license and suspension of the operator license.

Respondent, on the other hand, urged that he not be penalized for having exercised his right to a hearing, as he feels the Bureau suggested. The proposed findings then discuss Rolle's physical and mental makeup, largely in terms not supported by the record. The record did verify, however, that threats Rolle had made were subsequently denied or forgotten by him; he worried a lot about having his license revoked; and he has difficulty finding employment because of his huge bulk character, and financial, technical and other," it appears to have activated only the citizenship and technical requirements (Sections 97.37 - 97.49 of the Rules and Regulations). While Rolle's actions are clearly not compatible with the basis and purpose of amateur radio service (Section 97.1), the hearing examiner found nothing in the regulations which would authorize a refusal to issue a station license to Rolle, notwithstanding his reprehensible conduct, so long as he possessed an operators license, nor did the Bureau cite any.

Section 312 of the Act under which this action is taken, paragraph (d), placed a specific burden of proof on the Commission, or in this case, the Bureau. The Bureau has not sustained that burden of showing a proper basis for the revocation of the station license.

The Surprise Kicker

The proposed findings cited no regulation as violated and there was no such identification elsewhere in the record. The allegation of inconsistency with the general standard of Section 307(a) of the Act does not meet the test of Section 303(m)(1)(A). As in the instance of the station license, the show cause order omitted reference to the specific prohibition dealing with profane or obscene words, language or meaning, Section 303(m)(1)(D). According to FCC Examiner Frederick Denniston, *there is no direct prohibition against the use of amateur radio for criminal purposes*, which, if here present, would be conclusive in view of Rolle's criminal conviction for certain of the acts here involved.

The show cause order cited the making by Rolle of "communications of a threatening, abusive and/or indecent nature," and the proposed findings of the Bureau conclude that he had, in fact, done so. This quoted language is a modification of the language of the statute and Section 97.119 of the Rules and Regulations against "obscene, indecent or profane" as used in 28 USC 2464, which both the show cause order and the Bureau eschew, but the Bureau did not explain such a shift in language.

A review of Part 97 convinced the hearing examiner that Rolle's conduct had at least violated Section 97.115 prohibiting the transmission of music, Section 97.125 prohibiting willful and malicious interference, and Section 97.119. The Bureau substitute, which it employed in the show cause order, and the language of Section 97.119, however, have one word in common – "indecent" – one definition of which is "morally unfit to be seen or heard." Rolle's language clearly met this test, and the hearing examiner so concluded. To that extent, the "cause for the proposed suspension" required by Section 303(m)(2) had been properly given and was sustained by the record.

The FCC report summarized: "... the Bureau would revoke the station license on a charge of there being warrant for refusal to grant a license on an original application. The regulations, however, do not specify any basis on which an original application could be refused in the light of the conduct involved; nor does the Bureau indicate a basis outside the regulation which would sustain the action. The charge with respect to the operator license is violation of statute or Commission regulation but the specifications of the charge, "threatening" and "abusive," are found in neither. While the word "indecent" is in the charge and is in Section 97.119 of the Rules, the failure to cite that section, and especially the avoidance of citation to Section 303(m)(1)(D), dealing specifically with "indecent" language on the air, raises substantial doubt as to whether a proper basis has been shown for suspension of the operator license. Surely, the general public and especially the amateur radio operators, who have been subjected to abuse by actions such as disclosed here, are entitled to better protection in the form of clear-cut regulations and supporting procedures to eliminate such activities."

The license for amateur radio station W9FCE was NOT REVOKED, but the Technician amateur radio operator license issued to Armond J. Rolle was SUSPENDED until November 1, 1971

actively triggers it with tone. The fact that the user station does have tone would be sufficient to asssure that he is monitoring the repeater output. If the repeater then malfunctions or its emissions are contrary to the requirements of Part 97 – the user station can shut off his tone equipment to keep further signals from going through the repeater.

Other methods of repeater shutdown include transmission of a carrier for a specified time period (say 3 minutes), transmission of a continuous tone for a specified period (say 10 seconds), or the simple act of refraining from any transmission for a specified period (say 5 minutes). When the repeater is thus shut down, the repeater control licensee can be notified and repairs can be initiated.

If the no-monitor proposal is passed by the FCC, this step would mark the most significant advance in repeater rulemaking since the log-signing requirement was dropped several years ago.

Blind Ham Uses Repeater To Report Blaze

by W1WSN

A QRRR was placed on the WA1KFY repeater in Marlboro, Mass. on November 29, 1970 by W1FCJ, a sightless amateur who reported a fire in his building with accompanying heavy smoke. There was no telephone in the apartment and the FM transceiver was close at hand. The call was received by W1ELU and WA1NPT, who called the Cambridge (Mass.) fire and police departments. W1FCJ remained at his rig until the police arrived and was one of the last persons to be evacuated from the building. There were no injuries, but damage was extensive and heavy losses were suffered by W1FCJ and several other occupants.

and the U.S. – all the foreign lands receiver better marks for improving their products over the past decade than did the U.S. The best endorsement went to Japan, with 65% of the national sample and 79% of the high-income sample asserting that Japanese goods are better than they were 10 years ago. In contrast, only 33% of the national sample and 27% of the high-income respondents noted improvement in U.S. goods. Furthermore, one-third of both groups claimed that American-made products are not as high in quality as they were a decade ago. This is, by far, the largest negative vote given any of the four nations.

Even while believing that the quality of U.S. products are declining, Americans still have the greatest amount of confidence in domestically produced goods. Of eight products areas surveyed – mostly in the electronics field – only Japan and West Germany approach the U.S. in making products with comparable acceptance to American consumers.

In nearly all products areas surveyed in the Newsweek study, the U.S. maintains a commanding lead over its nearest competitors in both national and high-income samples. In the area of color TV, 76% of the national sample has a "great amount of confidence" in the U.S. product, 25% for second-place Japan. For black-and-white TV the U.S. has a 79% vs 32% "great confidence" lead over second-place Japan. In the category of radio, hi-fi, and tape recorders, the U.S. lead over second-place Japan is 69% vs 48%. The U.S. tops second-place West Germany in watches 62% vs 41%, in small household appliances 72% vs 19% and in automobiles 69% vs 37%.

For further information of this survey and for a demographic analysis of its findings, contact John G. Pontius, Newsweek Home Product Advertising Manager, at 444 Madison Avenue, New York NY 20022.

FCC REPORTS ISSUED

Volume 19 of the Second Series of FCC Reports is now available to the public from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Volume 19, covering the period from September 5, 1969 to October 17, 1969, contains 1,140 pages and is priced at $6 (catalog number 1970 O-LT 374-783).

The complete FCC report now consists of the first series of 41 bound volumes dating from July 17, 1934, to June 30, 1965; the second series of 19 volumes covering the period July 9, 1965 to October 17, 1969. Volumes 42 through 45 (covering documents not previously printed in the reports, Safety and Special Radio Services, and Common Carrier Matters) are now in preparation. A cumulative index-digest of Volumes 1 through 15 of the second series is available from the Government Printing Office for $7.50; a similar index to the first series will be prepared.

FCC PROPOSES HIGHER SPEEDS FOR RTTY

Use of higher speeds of 75 and 100 words per minute for amateur radio teleprinter operation has been proposed by the Commission in an amendment to Part 97 (Amateur Radio Service) rules. The present rules permit a speed of 60 words per minute.

The increase was requested by Keith B. Peterson (W8SDZ) and R. Bruce Peters (WB2LRS), who contended that the present commercial teleprinter standards include faster operating models as well as 60 words per minute machines; that the present maximum frequency shift of 900 Hz would not be exceeded, and the higher speed would stimulate the development of new amateur skills and techniques.

The Commission said it believed the use of additional teleprinter speeds in the Amateur Radio Service, in keeping with commercial equipment standards now in use, is desirable and that since increased speeds can be obtained within limits of the present bandwidth requirements, additional interference from the operation was not anticipated.

Comments are requested by March 1, 1971, and reply comments by March 22, 1971.

Action by the Commission December 16, 1970, by Notice of Proposed Rule Making (RM-1392, 1538). Commissioners Burch (Chairman), Bartley, Robert E. Lee, H. Rex Lee and Wells.

New Motorola Hep Functional Circuits

An all-new series of Motorola HEP audio functional integrated circuits are designed to provide a complete audio system for most ham/experimenter projects.

The HEP audio functional circuits are available in three power output levels. HEP type C6004 provides 1W of audio and is priced at $2.60. Type C6005 provides a minimum of 2W and is priced at $4.35. The 4W functional audio circuit is HEP type C6006 and sells for $5.60. All are high-gain devices; they include a preamp and provide full rated output with an input signal in the 10 to 15 mV range. The circuits can be used with 4, 8, or 16-ohm speakers. Mail-order source for Motorola HEP devices is:
Circuit Specialists Co. Box 3047, Scottsdale AZ 85257.

Fem-Foto of the Month

Mrs. Nelda Reifsteck (WA9XYZ) became interested in amateur radio as a byproduct of CD activities. She acquired a Novice license in May 1968, and shortly thereafter built a Heath HW16 transceiver.

In May 1970, she received her General license. Again faced with the need of a radio, she built the Heath SB-102 transceiver.

Nelda is active in civil defense work, president of the Women's Civil Defense Council of Champaign County, and president-elect of the Illinois Women's Civil Defense Council. She is reportedly the first woman in either council to obtain a ham license. She has received certificates for completing the civil defense courses in communications, medical self-help, mass feeding, home study course, and package disaster hospital training.

HAM NETWORK AIDS IN MEDICAL EVACUATION

Albrook AFB, C.Z., Nov. 25 An international network of amateur radio operators in Venezuela, Ecuador, Colombia, New Jersey, and the Canal Zone provided the emergency communications needed to arrange the medical evacuation of a member of the United States Air Forces Southern Command (USAFSO) Band on a good will tour in Maracaibo, Venezuela.

SSgt. Jerald O. Roys, a drummer with the band participating in festivities surrounding a fair in Maracaibo, was discovered on November 18 to be suffering from a possible ruptured spinal disk.

Immediate communication with the Canal Zone was necessary to ensure that the aircraft due to pick up the band the following day was equipped with a special stretcher and proper medical personnel and equipment.

When efforts to contact the Canal Zone through routine government channels were frustrated by uncontrollable delays, band officials sought aid from a local amateur radio station operator.

MSgt. Oscar B. Tinney, an announcer and interpreter with the band, and a ham himself, contacted a Maracaibo eye doctor, Dr. José R. Apitz Rhode, YV1EL, who checked into the "Intercontinental Traffic Net," a frequency encompassing hams listening in eastern North America, Central America, and South America. YV1EL checked in to the net control, a ham in Bogotá, with "urgent" traffic for the Canal Zone.

When the Bogota control station put out a call for the Canal Zone, he found that he was unable to contact anyone. However, WA2CFA, Mr. Selig Rachles, in Clifton, New Jersey, called in to explain that he could reach the Canal Zone and volunteered to relay any messages.

With this contact, YV1EL and WA2CFA contacted KZ5FH, Robert McClain, at Coco Solo on the Atlantic side of the Canal Zone, and the three stations went off the net to try to set up a relayed phone patch to the Air Force headquarters on the Pacific side of the Zone. While the relay proved workable, phone lines between the Atlantic side of the Canal and the Pacific side are so poor that a phone patch was not feasible.

Meanwhile, and without the knowledge of the other three stations, HC2HV, Helen Jones, in Guayaquil, Ecuador, had been listening to the unraveling drama and the frustrated communication efforts. Helen contacted a Canal Zone station on the Pacific side of the Isthmus and directed him to the frequency upon which the original three hams were attempting to patch their emergency traffic.

KZ5EE, TSgt. Ernest Wachter, came to their frequency and checked in. Sergeant Wachter who lives four blocks from the Air Force headquarters successfully completed the phone patch and the medical attendant and emergency equipment arrived with the aircraft the following day.

When the aircraft returned to the Canal Zone, Sgt. Roys was gently carried from the plane to an awaiting ambulance which was to take him to Gorgas Memorial Hospital. As the sergeant was lifted into the ambulance he managed a smile for his pretty wife, despite the pain, and rode to the hospital little cognizant of the international cooperation of amateur radio operators who came to his aid the night before.

DX BRIEFS...

A2CAK, Des, Box 23, Gaberones, Botswana, on 21013/2000Z. A2CAF says four active stations in Botswana. C21AA, Nauru, on 14130/0600Z, call on CW and he'll move up the band. CE9AT, South Shetlands, Rene, QSL to CE3RR. CT2AK, Jose, Azores, QSL to VE7BWG, on 7030/0830Z. CT3AS, Madeira, QSL RSGB, on 14213/2200Z. EA9EJ, Justo, only active operator in Rio de Oro, no other licenses granted so far, on 14160/0600Z Friday & Saturdays. FP0CA, St. Pierre, 14203/2130Z, QSL to K2OJD. HS1ABH, Thailand, Clay, QSL to W5ZG, on 14203/1230Z. KH6NR/Kure, 14230/21295, QSL to KH6NR. ST2SA, Sid, 14220/2200/1330Z, QSL Box 253, Medani,

Clipperton, Anyone?

While Clipperton (FO8) seems to be the most wanted country these days, there are several difficulties ahead for any projected operation from here. You'll find this little French dot on your world map in the Pacific if you look south of Baja California and west of Costa Rica. There is nothing anywhere near it. The weather and the seas pose a problem even in the best months of September and October. Waves that run as high as 40 ft at times and steady winds of 15–40 mph add to the problems. The island is surrounded by a beautiful coral reef, which makes landing

All ARRL Directors Reelected

All incumbent directors running for re-election were reelected. Perhaps, if a little more planning and thought are put into the and Midwest directors will not, I believe, be running again, so changes in those divisions seem inevitable. Will it be a change for the

RTTY NET FORMED

There has now been formed a new section net for Ohio. The mode for this new net is

1971 elections, it will be possible to get in at least one new face! Let's give it a try.

To run for director an amateur must be 21 or over, hold a General Class or better license, and have been a member continuously of the ARRL for at least four years before the date of election. If you know of any amateurs in your area who meet these stringent specifications and also have enough of an interest in amateur radio to offer their services for a two year stint as an ARRL director, it is time right now to start planning the campaign.

Incumbent directors have a tremendous advantage over a newcomer. The average League member votes for the chap that he has at least heard of before . . . and this usually turns out to be the present director. To counter this a new man must spend several months getting around to clubs introducing himself and finding out what they want from him in the way of representation at HQ during those few crucial hours of the yearly directors meeting.

With your help we can all have a bigger and much better ARRL . . . but we must get new faces into those director chairs before any changes are even remotely possible. The 1971 election of directors will give you an opportunity to make changes in the Atlantic, Dakota, Delta, Great Lakes, Midwest, Pacific, Southeastern and Canadian divisions. Some of those, such as the Southeastern, are in unbelievable need of improvement. The Pacific better? That is up to *you*.

The man you run for director must be okayed by the ARRL Executive Committee by the way, and this can take quite a few months if there is even the slightest question that can be raised. No person is eligible who is commercially engaged in the manufacture, sale or rental of radio apparatus capable of being used in radio communications, is commercially or governmentally engaged in frequency allocation planning or implementation, or is commercially engaged in the publication of radio literature intended in whole or in part for consumption by radio amateurs.

Petitions for nomination must have a minimum of ten names of full members of the ARRL in good standing . . . and this good standing should extend to beyond the date for voting in November to be on the safe side. Get the petitions in as early as you can because the Executive Committee may drag out the acceptance of your candidate for several months . . . or longer. One candidate in this last election was held up almost a year, with the decision being rendered a few days before elections, much too late for any possible campaigning. Do you suppose they didn't want this chap in? You bet they didn't!

Even the most vested of interests can be changed if you decide that you are going to take matters into your own hands. Let's work toward getting some new directors, eh?

radioteletype. The essential statistics for the net are as follows:

Time	1800 EST (2300 Z)
Frequency	3605 kHz
Meets	Monday through Sunday
First Net	Sunday, January 10, 1971

All through traffic will be handled through the Buckeye Net (CW) representative but dependable liaison must exist with both Buckeye Net and Ohio Single Sideband Net. At present only about half of the available positions are filled so there is still plenty of room if you wish to volunteer for either an NCS or Liaison position. The net roster calls for a total of seven NCS stations and fourteen liaison stations weekly.

The details of net operation are as follows. The NCS will begin the net call-up at exactly 1800 EST. The call-up will be by radioteletype. Stations will then check in by CW. The CW running speed of the net will be 13 WPM but the NCS is instructed to slow down if a station is having difficulty. We do not want to make CW an obstacle in what is essentially a RTTY net. Any directions given by the NCS are to be in CW and acknowledgement of QNI will be in CW. Traffic itself is to be sent on RTTY. The two stations involved in handling the traffic have the option of either obtaining fills by CW or RTTY, whichever is most convenient. Tapes and reperf should be utilized whenever possible to speed up net business. Most small amounts of traffic will be handled on the net frequency but for large amounts of point to point traffic, the two stations should be sent off net frequency by the NCS. A more complete discussion of RTTY traffic handling as it will be done on the net may be found in *The Radio Amateur's Operating Manual*. Incidentally, a "confirm" line at the end of the text repeating the addressee's name and all numbers in the address and text will be expected so please include it.

Sudan. TA3HC, Horace, 28590/1500Z, QSL to XE1EEI. Note: no legal TA stations as yet so do not QSL to Turkey. TR8VW, 28595, QSL to Box 5050, Libreville, Rep. Gabon. Do not mention radio on envelope! VP2KX, St. Kitts, QSL RSGB. VQ9SM, Chagoes, Jacky, 14231/1600Z, QSL to JAØCUV. Also try him 0100-0200 same frequency. YBØAU, Tom, 14058/1100Z, QSL Box 2761, Djarkata, Indonesia. YK1AA, Rasheed, is back on the air Fridays and Saturdays from Damascus, 14228/1300–1600Z long path. ZD5T, Ray, 28590/1800Z, QSL to Box 680, Manzini, Swaziland, Africa. ZK1AA, Cook Island, 14080/0400Z, QSL's. 5U7AR, 21073/1800Z, QSL to Box 442, Niamey, Niger. 8J1RL, 14113/1400Z, Fuku, QSL to JARL. QTH Showa Base, Antarctica. K3QOS/KB6, Canton Island, Odus, 14225/1500Z, listen 0500-0700Z also. QSL to K3QOS. K6AZD/KB6, 14330-35, Norm, 0300-0530Z, QSL K6AZD. KH6AZB/KB6 is also on Canton, up on 10m. UAØYT,14055/0200Z, in zone 23 (as are all UAØY-stations). QSL Box 60, Kzyzl, Tuvinian ASSR, USSR. TR8DG, Guy, 14210/2330Z. VP8LR Falkland Islands, 14214/2300Z, Tony, QSL to WB4FIN. Laccadives expedition set for February 14th with VU2CK-DK-RK-KN operating. They've been trying for this one for years and finally got permission. Few DXers don't need this one so you should be able to hear the pileups even with your receiver turned off. ZD7BB, St. Helena Island, Eric, 14205/0030Z, medium rare these days, QSL c/o Post Office, St. Helena. ZD7SD, Bill, 14210/2100Z, QSL WA2DWE. ZK2AG, Niue Island, 14220/0200-0400Z weekends, QSL ZM4NH, very rare. ZS2MI on again with new operator Fanie, 14192 (listening 14200) 0330Z. Thanks to Gus, WCDXB, and other sources. Any DF info appreciated. Deadline for next issue 20th of month.

extremely precarious. Past visitors have managed to jump onto the wreckage of an LST just off shore. Many unsuccessful attempts have been made to land on Clipperton, only to be foiled by winds, high seas, and unbelieveable ocean currents.

To further complicate the problems, recent reports from commercial fishermen in the area indicate that two French naval vessels are there, one a minesweeper type and the other a helicopter ship. Fishermen approaching the island are headed off. There appears to be a crew ashore working and living on the island with a new bunker under construction. It is also reported that those in authority to give permission to land are extremely difficult to contact.

The last time Wayne Green visited the Clipperton licensing authorities in Tahiti (in 1966) he found his FO8AS Clipperton license to still be valid. Since then he has not had the time or the money to organize an expedition, but has been in contact with others interested in the trip, hoping to be able to go along. Nothing is definitely in the wind as yet.

Chicago Area Hams Hold "Hamboree"

The Chicago Suburban Radio Association, a not-for-profit organization, will hold its annual "Hamboree" on March 21, 1971, at the Operating Engineers Hall, 9200 West Joliet Road, La Grange, (Countryside) Illinois. All Hams and the public are invited. An attendance of 3000 to 5000 is expected, based on previous years.

According to Dean C. Ford (WA9SEF) Program Chairman, 805 S. Stone Avenue, La Grange, Illinois, the latest amateur radio equipment will be on display and sold by major manufacturers and Hams. All Hams are invited to come out and display or sell any products or items they wish free of charge. The exhibit hall has 10,368 square feet of exhibit space. Ample paved parking space will also be available at no added charge.

Drawings for three grand prizes valued at $1000 plus a number of lesser value prizes will be held during the one-day Hamboree. All those who attend will be eligible for the drawings. A donation of $1.50 per person at the door is the admission charge. Advance tickets for only $1 per person, or a savings of 50 cents, may be purchased from:

Mr. Wilson Thomas (W9KWA)
4017 Vernon Avenue
Brookfield, Illinois 60513

REPEATER CONVENTION

The Texas VHF-FM Society will hold its semiannual convention at San Antonio, February 26, 27, and 28, 1971.

This society holds a business meeting, as opposed to a hamfest, and all southwest amateurs interested in the technical aspects of repeater construction and operation should find the Saturday and Sunday sessions very informative.

Among other attractions will be a special program for XYLs and Jr. ops, a family dinner, new equipment exhibits, and prizes.

The San Antonio Repeater Organization will host this convention and arrangements have been made for preregistration at the El Tropicano Hotel, site of the convention. All interested parties are requested to write for a preregistration package. Inquiries should be addressed to:

San Antonio Repeater Organization
P.O. Box 1753
San Antonio TX 78206

PRESQUE ISLE HAMFEST

Don't forget to mark your calendars for the date of Feb. 27, when the Presque Isle ARC puts on its big hamfest. Advance info can be obtained from Box 1021, Erie, PA 16512.

QRP 10th ANNIVERSARY QSO PARTY

Starts: 0000 GMT Saturday March 13, 1971
Ends: 2300 GMT Sunday March 21, 1971

This contest is open to all amateurs, whether they are members or not of QRP ARC INTL. This contest is for CW only, and all are eligible for awards.

Exchanges: Members: RST, ARRL section or country, QRP number. Nonmembers: RST, ARRL section or country, Power, NM (nonmembers).

Frequencies: CW – 3540, 7040 14065, 21040, and 18040. Novice – 3710, 7160, and 21100.

Scoring: Stations may be worked once per band for this week-long party, for QSO and multiplier points. Each member contact counts as 3 points, nonmembers count as 2 points. As an incentive to participate in this contest, DX QRP members only may claim 4 points per contact. Total QSOs multiplied by ARRL sections or countries worked. There is an additional power multiplier as follows: 100W input X1, 25–100W input X1.5, 5–25W input X2, 1–5W output X3, below 1W output X4; the total is your final score.

Awards: Certificates will be awarded to the highest scoring station in each ARRL section or country. Certificates will also be awarded to the top three places in W/VE, and worldwide (KH6, KL7 DX). The lowest power station in contest submitting a log showing at least three genuine skip contacts.

Logs: Logs must be readable, show date/time of QSO worked, exchanges sent and received, band used, emission type, equipment, power and computation of score. Include a declaration that all rules were observed, and send to Contest Chairman by April 10, 1971. Send to: Elmer J. Worth K3YNN, 946 Franklin Street, Reading PA 19602. Also if anyone wishes information on the QRP ARC it may be obtained by sending a self-addressed stamped envelope to K3YNN.

Swap 'n' Shops

The 4th annual Blossomland Amateur Radio Auction and Swap 'n' Shop! will be held Sunday, March 14, 1971 at the Shadowland Ballroom, Silver Beach Amusement Park, Benton Harbor–St. Joseph, Michigan. Doors open at 9 AM EST.

Over 1000 amateurs turned out last year for Southwestern Michigan's fastest growing ham event . . . and went away with carloads of good gear (and money). This annual auction has grown from less than 100 attendance in 1968 to over 1000 . . . and this year promises to be a lot bigger!

Half an acre of indoor space will be available for the Swap 'n' Shop and auction to accommodate the trailerloads of bargains that will show up. Hot food . . . indoor restrooms . . . acres of free parking . . . drive-up unloading . . . you name it and we've got it.

Coming from out of town? Just follow Interstate 94 into Benton Harbor – St. Joseph from the east or west; get on U.S. 31–33 if you're coming from the south or north.

Check your schedule and shack now . . . and be at the Benton Harbor Ham Auction on Sunday, March 14. You really can't afford to miss it!

The Huron Valley Amateur Radio Association 4th annual Swap 'n' Shop will be held on Sunday, March 7, 1971 from 9 a.m. to 5 p.m. at the Pioneer High School, Stadium and Main Streets across from the University of Michigan football field, in Ann Arbor, Michigan. Adequate free parking, easy access, an auction, and many surprises. Talk-in on 146.94 FM and 3930.

Donation is $1.25 in advance, $1.50 at the door. For further information write W8KGG 2729 Packard Road, Ann Arbor, Michigan.

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business venture. No display ads or agency discount. Include your check with order. Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February. Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads. We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue. For $1 extra we can maintain a reply box for you. We cannot check into each advertiser, so Caveat Emptor. . .

MOTOROLA FM - 2 meters; U43GGT, 40 watts output, transistor supply, very clean, with cables and control head, less crystals - $145. 80D Transmitter strip - $15. Sensicon A Receiver - $20. Complete 80D, Dynamotor supply with cables and head - $40. WA1INO, P.O. Box 587, Manchester CT 06040.

IMPORT AND SAVE $$$. Japanese ham gear catalog- $2.00 (Refundable). Over 60 rigs illustrated. K4EPI, R. Guard, Box 99, Dept. 73, Lacey's Spring, Alabama, 35754.

JIG SAW PUZZLES WANTED. Lover of those wooden jig saw puzzles is looking for any that might be still around in your attic or closet. There used to be thousands and thousands of them so there must be a few left. If you have some that you would like to find a good home for, write to Wayne Green, Peterborough's most avid jig saw fan. Peterborogh NH 03458. State price, if any.

OHIO- Intercity Radio Club is holding their Annual Ham Auction Friday Feb 5 at the Naval Training Center, 170 Ashland Rd., on U.S. Route 42, in Mansfield, Ohio. Look, swap, buy at 7:30 P.M., Auction at 8:00 P.M. Eats. Eldon Heck W8PO, Rt 2, Box 195, Shelby OH 44875.

WAYNE, LIN, KEN and the entire staff of 73 wish you a superbly joyous Groundhog's Day, Washington's Birthday and Lincoln's Birthday. Frankly, unless you have a currently valid subscription, only a few of us have good wishes for the rest of the days of the month. Our very best wishes can be obtained on a temporary basis by means of a gift subscription for a friend.

HEATH SB-310 RECEIVER,mint, professionally aligned, deluxe SSB crystal, plug in crystal for 15 M novice band, $235. William L. Reeve WB9DVV, 335 No. Elmwood Lane, Palatine IL 60067.

ELECTRIC ORGAN, basic spinet kit, transistorized, known make, limited supply, send SASE for particulars. L. G. Hanson W9YCB, RR 2 Box 52A, Angola IN 46703.

TINY LIKE-NEW HANDIE-TALKIE. HT 220 OMNI; Motorola's latest pocket transceiver. About 6½ watts rf out, two tone freqs (1950 and 2100 Hz); crystaled and operating on 146.34/146.94 and 146.94 "direct." Receiver very sensitive (0.25μV for 20 dB of quieting). Includes Ni-Cad battery and new Motorola charger. $550 cash. Ken Sessions K6MVH, 73 Magazine, Peterboro NH 03458. Phone 603 924-3873 (at work).

MAGAZINES. Fifty year personal collection of ham radio and photo publications. Also gear. SASE. Jack Stuart W53G, Box 991, El Paso TX 79946.

SWAP excellent R-390/URR for 5-band transceiver plus $375. Will pay shipping anywhere. Roland Guard K4EPI, 750 Lily Flagg Road, Huntsville AL 35802

2M FM GALAXY FM210 with AC power booster and two sets of crystals and manual. $195. John Stiles K7DGV, Box 114, Sweetgrass MT 59484.

WANTED: COLLINS 51 J4 or 51 S1 receiver in good condition. M. Eisenber, P.O.Box 5171, Los Angeles CA 90055.

FOR SALE: HT 37 excellent cond. $160. Viking Valiant $75, excellent, with mike for P.T.T. SX101 MK III, extremely clean $90. All FOB. Phone 904 264-2738. R. L. Sturgis WB4BYJ.

VHF DISCONE ANTENNAS. New surplus AS-408/U discone antenna covers 200 to 400 MHz. Will ship postpaid. $22.50. Frank Hajdu, 41 Ledge Lane, Stamford CT 06905.

FOR SALE: John F. Rider Radio Troubleshooter Manuals, Vols. 1 to 17, approx. 75 Sams Folders, loads of TV and Radio manuals such as RCA, Philco, Zenith and others; Simpson 325 Signal generator, Eico 425 Scope, Eico 360 Sweep Generator, Heathkit Signal Tracer, 25 Relays and other parts. The whole works for $400 FOB Bronx NY. Tel. 212 652-2416 (evenings). Jack Naimann, 201 E. Mosholu Pkwy, Bronx NY 20467.

FOR SALE, highest offer takes following ppd.: Knight TR-108 2-meter transceiver with Heath HWA-17-2 FM converter; Globe HG-303 75-watt 10-80 meter transmitter; Eico HF-81 stereo preamp, 488 electronic switch, 1020 power supply, 221 VTVM, 950-B RC comparator and bridge, 460 scope; Heath MP-10 12-volt to 110-volt inverter, SG-8 signal generator, TC-3 tube checker; Ballantine 314 audio VTVM; Fisher 50-C-4 mono preamp; Ten-Tec PM-3 transceiver with AC-5 antenna tuner. Also for sale, complete professional home burglar/fire alarm system, never installed, send s.a.s.e. for data sheet and description, Pete Stark, Box 209, Mt. Kisco NY 10549.

1971 AMATEUR ALLOCATIONS

TECHNICIAN

CW & PHONE: 50.1–54.0, 145–147, 220–225, 430–450, 1250–1300, and up.

GENERAL

CW: 1800–2000, 3525–3800, 3900–4000, 7025–7200, 7250–7300, 14.025–14.200, 14.275–14.350, 21.025–21.250, 21.350–21.450, 28.0–29.7, 50.1–54.0, 144–148, 220–225, and up.*

PHONE: 1800–2000, 3900–4000, 7250–7300, 14.275–14.350, 21.350–21.450, 28.50–29.7, 50.1–54.0, 144.1–148, 220-225, and up.*

ADVANCED

CW: 1800–2000, 3525–3800, 3825–4000, 7025–7300, 14.025–14.350, 21.025–21.250, 21.275–21.450, 28.0–29.7, 50.1–54.0, 144–148, 220–225, and up.*

PHONE: 1800–2000, 3825–4000, 7200–7300, 14.200–14.350, 21.275–21.450, 28.5–29.7, 50.1–54.0, 144.1–148, 220–225, and up.*

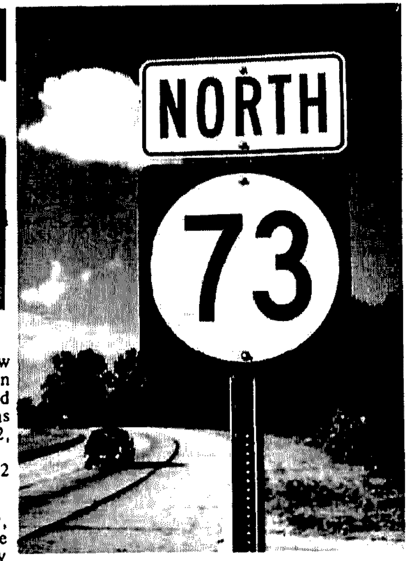
EXTRA

CW: 1800–2000, 3500–4000, 7000–7300, 14.000–14.350, 21.000–21.450, 28.0–29.7, 50.0–54.0, 144–148, 220–225, and up.*

PHONE: 1800–2000, 3800–4000, 7200–7300, 14.200–14.350, 21.250–21.450, 28.5–29.7, 50.1–54.0, 144.1–148.*

MILITARY SURPLUS. All new. Electronics, devices, components. Compare and save. Catalog 10¢ (stamps or coin). Electronic Systems, P.O. Box 206, New Egypt NJ 08533.

LISTING SERVICE- Gear to sell? Need rig? Sellers- $1.00. Lists information year. Buyers-free. SASE brings details. Listing Service, Box 1111, Benton Harbor MI 49022.



73 Everywhere

I guess you people at 73 never realized how popular your magazine really was. They even named beer taverns and billiard parlors and barber shops after this famous rag. It seems that after they built N.J. state highway 72, they had to name the next one "73".

E. L. Klein Jr. WB4AYE/2

Think!

I like 73 technically and informationally, and occasionally editorially. Ken and Wayne serve a purpose in keeping the fraternity stirred up with their sometimes caustic comments. THINK and then ACT! If you believe in a program, proposal or whatever, don't just sit back and let George, Joe, Tom, Dick or Harry do it – do it yourself! I happen to be one of those who agree with incentive licensing. It got me off my duff to get the Advanced, and when I finish the three courses I am currently enrolled in I plan to go for Extra. My field is administration, so anything I know about amateur radio is strictly self-taught or taught by my fellow hams more generously blessed with talent. For me it comes hard, but I will make it.

Please advise your readers that I have answered nearly all the QSLs received for KM6DU/KH6 (Kure Island) and anyone who has not received theirs by this time should QSL via K7UNB (direct or bureau) and I will answer sometime after March, as I will be in transit until then. I answer all cards received, SASE/IRC or not. A number of cards have probably been lost in the mail, a not uncommon occurrence from indications. One party after his fourth try wanted to know if I really existed. Sorry 'bout that. A few have referenced QSOs for times/dates KM6DU was not on the air either from Kure or Midway – either a mistake or a pirate.

Hal Thompson
Rt 3, Box 1530
Roseburg OR 97470

After reading Never Say Die and Letters in the December issue I am forced to add my two cents' worth. Early last spring I wrote 73 about FM oriented articles appearing to the exclusion of all others. At this writing, the editorial and news pages continue to center on FM; and while the balance in article subject matter is better than it was it is still slanted to a small segment of ham activity.

A quick check of total pages shows 1970 to be behind 1969 by almost a full issue. This alone is bad enough but when you delete the "arty look of articles" there is even less of redeeming value.

It would seem that Mr. Sessions is more qualified to conduct the Radio Today side of the business with perhaps a monthly FM column in 73. This would leave the remainder of the enterprise to someone with the knowledge, desire, and capability of conducting a magazine devoted to amateur radio. Perhaps it would not allow trips to Jordan and the like but I am convinced that Wayne's personal efforts continue to be necessary to the editing and selection of subject matter for 73.

Bill Turner WAØABI

Compare 73's 1970 page count with our nearest competitors and you'll find we're still way ahead. Why not give FM a go, Bill. Five will get you ten you'll get hooked, too.

. . .Ken

WANT TO BUY: TS239 (LaVoie 239) manual. David Potter, 2844 San Gabriel, Austin TX 78705.

FOR SALE- HT 37 $150, NC 270 $75, both for $200. Johnson TR Switch $15. Charles E. Bailey W9HUX, 915 Doolin, Jacksonville IL 62650.

G. E. POCKET RECEIVERS Model SB03VE6. Operates with tone or normal squelch, Exc. condition $50. Lou Miniver WA7KRP, 1975 No. Yellowstone, Idaho Falls ID

GET YOUR "FIRST!" Memorize, study – "1970 Test-Answers" for FCC First Class License, plus "Self-Study Ability Test." Proven. $5.00. Command, Box 16348-S, San Francisco CA 94126.

FLYING HAMS: Trade your excess gear for avionics equipment. All lines available in the box or installed in your aircraft. All fully warranted. Interested in all lab test equipment, ham or military type gear. Powell Avoincs, FAA Repair Station #711-1, Box 106, Fayetteville NC 18302. 919-484-0236, nite 483-9426.

MANUALS— R-390/URR, R-390A/URR, USM-24C, BC-639A, SP-600JX, BC-348JNQ, URM-25D, UPM-45, UPN-12, OS-8C/U, CV-591A/URR, BC-779B, TS-186D/UP, TS-587B/U, $6.50 each. S. Consalvo, 4905 Roanne Drive, Washington DC 20021.

GALAXY FM210 with AC210, mobile antenna, microphone, xtals and FET preamp. $250 or best offer. WB2DMU, 4767 Lake Rd., Burt NY 14028.

INTEGRATED CIRCUITS - new, guaranteed. DTL gates, F6F, lamp drivers, MSI - 1 of 10 decoder, 4 BIT SR. T^2L MID '71 - other components, Mitch-Lan Electronics, Dept. 7371, P.O. Box 4822, Panorama City CA 91412.

WANTED: Coil Sets E, F, and AD for Receiver National H.R.O. 60. Write or call 4 PM. Pat Rapuano, 32 Seneca Rd., Seneca Falls NY 13148. Phone 315-568-8866.

NEW 4-1000 A, socket, chimney, and filament Xformer, $110. RCA CV-57 Converter. Almost new $75. PCA-2T Panadaptor, 455 kc 200 cycle, and manual. $45. Write 4183 Lonnie St., Oceanside CA 92054.

THE 20th ANNIVERSARY DAYTON HAMVENTION will be held on April 24, 1971 at Wampler's Dayton Harra Arena. Technical sessions, exhibits, hidden transmitter hunt and an interesting program for the XYL. For information write Dayton Hamvention, Dept 7, Box 44, Dayton OH 45401

LAST CALL FOR 1963 73. Bound volumes of 1963, regularly $15, while they last only $7.50. Act now! 1963 was a very good year. 73 Magazine, Peterborough NH 03458.

FOR SALE: Heath "Sixer" with push-to-talk, output meter, power supply, halo antenna, manual. $40 or best offer. Bud Michaels WB2WYO, 713 High St., Victor NY 14564.

2M FM- MOTOROLA D43GGV- Excellent condition with crystals, preamp and tuned up transmit 146.34, 146.94, receive 146.94. $85. Motorola R394 receiver with AC power tuned with crystal, spare tubes 146.94. $35. John L. Sielke K3HLU/4, 320 S. Macarthur Ave., Panama City FL 32401.

SELL mint, A-1 Collins KWM-2, AC supply and speaker, 301-1. Belongs to estate of the late K4FLI. Mike Burkhead, RFD 1, Henderson TN 38340.

RECEIVERS: RBA, RBB, RBC with power supply and cable. Also, R-511ARC, 190-550kc, R-509ARC 108-135mc, SASE other items. J. Lisaius, 116 Orton Rd, W. Caldwell NJ 07006.

MAKE MILLIONS? Hundreds? Sell Instant Gourmet Kits (eight herbs and spices in beautiful red plus wallet) to local gift shops, stores. Dandy gift item for friends, businesses, travelers. Why be poor? List for $5, your cost $26 dozen. Instant Gourmet, Peterborough NH 03458.

DERRICK ELECTRONICS will not be undersold on new Swan, Drake, Galazy, Hy-Gain or Mosley equipment. Check around, then write, Box 457, Broken Arrow, OK 74012.

MODEL 19 TELETYPE, good operating condition, for sale or trade. (202)-234-4678, P. S. Richter K1SDX/3, 2727 29th St. N.W., Washington DC 10008.

WEST COAST HAMS ouy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland CA 94607. 451-7755, area code 415.

WANTED – Duplexer for 148.01 MHz. Receive, 143.99 MHz transmit. State manufacturer, condition, model and price. Legare Hairston WA4VNN, 1013 Pecan Drive, Monroeville AL 36460.

SALE THREE ELEMENT TRI-BAND FIBERGLASS QUAD ANTENNA with aluminum cross arms, tee and instruction book. Originally purchased from U.S. Fiberglass Co. Sixteen foot aluminum boom and quad antenna book added free. $105 cash. FOB L. P. Thomason W4GVT, Jacksonville FL 32225.

DERRICK ELECTRONICS HAS ANTENNAS. We'll give the best deals on Hy-Gain, Mosley, Cushcraft, Rohn, Tri-Ex, Easy-Way, Tristao. Box 457, Broken Arrow OK 74012.

FOR SALE OR TRADE RCA 450 transistorized 12-V unit, two freq rec & tran in exec. cond. $50, or 6-meter motorcycle unit. WB5CDJ, Route 4, Box 75A1, Shawnee OK 74801.

GSB-2SSB SOLID STATE TRANSCEIVER, perfect condition, no trades, best offer. Bob Gilmartin, 1715 Diana Blvd, Merritt Island FL 32952.

LETTERS

Nincompoops

Ref. Dec. 73 contents page *Receiver Offset Tuning, etc.*, who is the egotistic ignorant, punk nincompoop responsible for the subhead for this article, *"For tuning in oldtimers who can't stay on frequency."*

Reminds me of the type of character who, if he can't see it, touch it, smell it or taste it – it isn't. Nothing happened before he was born. If he doesn't know it, it isn't. The mark of not only the common man but of a character contemptuous of the older people who made ham radio in the first place, men who didn't memorize test articles in magazines, but who had to dig out the information almost alone. This type of oldtimer didn't pass a memory test, run down to the nearest equipment emporium, buy a package and an antenna and mike, then go on the air to yak for the rest of his life, never building anything except possibly a kit where you need to know nothing and above all, you learn nothing.

I will wager that any hundred oldtimers will burn the long hair, beards, and sideburns off any equal number of characters such as who made that subtitle, in any test of "being on frequency." Any takers?

What do you say?

Harold L. Feighner W8BPB
5210 Three Mile Drive
Detroit MI 48224

I am the nincompoop that wrote the subhead. My hair is not particularly long, no remarkable sideburns, and no beard at present. (You didn't like Monte Wooley?) If there are any OOTCers or QCWA members whose sense of humor has atrophied enough to accept an apology for my remark they may have it. Now Harold, if you will start tuning our phone bands a bit, you will find that oldtimers like you and I are often off frequency. Have you ever listened to 3999?

...Wayne

I Won!

Many thanks for acting so promptly on my request for your book, *Take Your Traffic Ticket to Court and Win.* It came within three days of my request and I am delighted to say that it gave me the courage and know-how to go to court and defend myself.

My performance would never have won any Oscars but it won from the judge a most pleasant "case dismissed."

Mahalo to you and my best alohas.

Tom Doyle

Wish I'd got off that easy. Narrowly missed getting hanged.

...Ken

What's Been Happening?

Living in Wyoming and devoting my time to educational TV and radio I have kinda lost track of amateur radio. Even tho I have an amateur Extra ticket I have not been on the air for about 3 years. Several questions have come to mind over the years which I'm sure your mag will help answer – such as: Does the ARRL still exist? Do we still have 80 & 40 meters or do we now operate on some SHF freq. etc. etc. It seems most hams around here are not aware of operation below 144 MHz and are working very hard putting in repeaters etc. etc. in order to communicate a hundred miles or so. I mentioned lower freq but they looked at me like I was stupid! I must admit I am not knowledgeable on current amateur happenings. Please fill me in.

Dave Worley W7BQY

Three years? Little has changed. ARRL, last we heard, is still around. Repeaters are becoming epidemic – better look into it.

...Wayne

FM Clubs

I read your magazine every month and especially enjoy articles related to FM operation on 2 meters.

Can you tell me what amateur radio clubs are located in the New York City metropolitan area, what clubs in my area use 2 meter FM as their sole method of operation and what repeater stations are in the Brooklyn/Btonx, New York area, in addition to their frequencies.

I want to join up with a local club and especially want to learn more about FM communications on the ham frequencies.

Douglas Townsend
Graphic Services
The Rockefeller University

Can't say about the clubs. For repeaters, you have several: K2OOP on .22/.82; K1TKJ on .25/.73; K2HOI and others on .34/.76; simplex on .94.

...Ken

Wayne for League Manager

I think Wayne Green is about the only person who can save ham radio. At least he is the only one who seems to be really trying. I don't think too much of K2AGZ sometimes (very often) but I suppose you have to have someone controversial on the staff (someone else, that is, so the guys let up on Wayne a bit).

Mike Czuhajewski WA8MCQ

What's The Beef?

I have only read a few of your magazines, but I can tell at a glance you are 100% anti ARRL. What's the big beef? If you don't like the way ARRL does things and you think you can do it better and have the support of the majority, start your own group and send people to Washington, etc. If the League has so much money you ought to be able to raise much more because you have so many on your side. I have only been in ham radio a few months, and all I know is that if I get my General or Advanced ticket it will be because of books and helps put out by the League.

I was copying W1AW code practice and a bunch of lids got right on freq. and loaded up and sent a bunch of gibberish (not one call sign so anyone would know who they were) just to louse up W1AW. That really takes "brains". You *ANTI* people make me sick. You are just like these kids that are against the Establishment, but don't have any reasonable alternatives, except to tear down and destory. Sure the ARRL isn't perfect, but until you blowhards get off your soap boxes and start a better League, it is the only thing we've got.

Thanks for letting me blow off a little steam.

Jim Nilson WN9ETH
4412 Marsh Ave.
Rockford IL

Where do you think ham radio would be today if the League was allowed to go unchecked? If the League had its way in 1967, Generals would not be permitted to use phone.

...Ken

New Repeater?

For a while I have heard a rumor that someone is putting one on the TV tower on Mt. Ascutney. Ascutney is visible from my house and results should be very fine, but I can't find out if such a repeater is indeed in operation or the frequencies they use. Do you have any info on this one?

Bill Deal K1CLD
Piermont NH 03779

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...Ken

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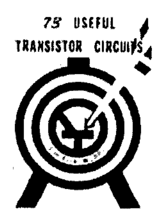

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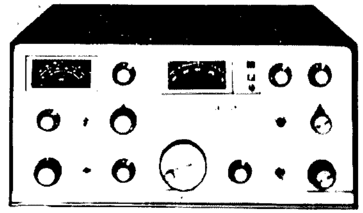

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NEW APPROACH for the metal locator

Irving M. Gottlieb W6HDM
931 Olive Street
Menlo Park CA 94025

During the past several years, a number of metal locators have been described in technical literature. An excellent example is the constructional article which appeared in the July '67 issue of *Popular Electronics*. The design philosophy of these locators has been directly inherited from vacuum-tube technology; it has generally been found that a decided upgrading in performance could be reliably attained from the mere conversion to solid-state circuitry. Nonetheless, I have long felt that a little imagination might be profitably unleashed toward a somewhat *different* approach to the electronic detection of metallic objects. After ruling out "change for change's sake," the reasoning evolved as follows: The transistor AM radio has become such a popular item that actual replacement is now the accepted "servicing" method. Why not use the very considerable amplification available from even the most inexpensive of these sets? And, to make the project just a bit challenging, why not stipulate that *no surgery of any kind be permitted on the set?*

Shortly after formulation of this idea, it was discovered that a superficially similar approach had been anticipated and implemented by others. However, in all situations investigated, there was either *dependency upon a broadcast station*, or *modification of the radio's circuitry*. These techniques were rejected as undesirable. One, then, was left with the clear objective of developing a scheme which would enable the deployment of *any* transistor radio in an arrangement capable of providing a response to metallic objects: This would be accomplished *without electrical connection to the set*, and would involve *no operational dependency on broadcasting stations*. (An added feature of such stipulations is that the radio could be immediately used for its intended function if so desired.) Not only were these objectives achieved in a straightforward manner, but performance definitely exceeds that generally obtained from the conventional locator. The ensuing discussion describes the theoretical and practical reasons why this is so:

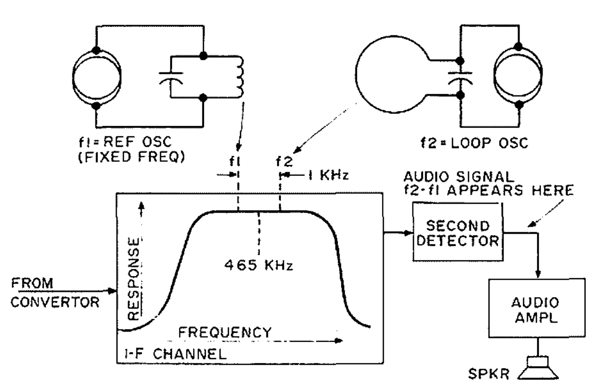


Fig. 1. Block diagram depicting basic concept of locator. The two oscillators are "radiation-coupled" to receiver's i-f channel. Converter plays no role in this scheme, and tuning is of no consequence except that it is desirable to be tuned between *stations to avoid their interference. ference.*

Principle of Operation

The principle of operation involves "immersion" of the transistor radio in *two* electromagnetic fields. Both of these fields are at frequencies within the passband of the i-f amplifier of the radio. (Because of the proximity of the oscillators which generate these fields, we have considerable latitude with respect to where these frequencies enter the response curve of the i-f amplifier.)

The field produced by one oscillator is at a *fixed* frequency during a search for a metallic object. This frequency is generated by the reference oscillator (Fig. 2) and consists of the circuitry associated with Q2. The field produced by the other oscillator (Fig. 3) is subject to "pulling" by the effect of eddy currents induced in a metallic object when it is approached by the exploratory loop. If the two frequencies are initially different by an audio frequency, say 1 kHz, a change of pitch will be heard from the radio speaker. The audio tone is actually a heterodyne product of the two interacting frequencies, and is generated by the second detector of the radio. One might say we have harnessed one of the ancient plagues of the superheterodyne circuit, the "birdie." But, unlike inadvertent ones, this deliberately created birdie is extremely strong and stable.

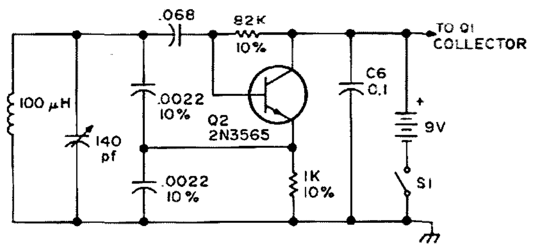


Fig. 2. Schematic diagram of reference oscillator. This oscillator is situated inside the box on the handle.

It will be noted that the customary multiturn wire loop has been replaced by a single turn of sturdy copper tubing Those with experience in the construction and operation of locators will quickly grasp the significance of this innovation. Not only is the winding to a wire loop attended by danger of shorted turns and difficulty in reproducing an author's results, but such loops often contribute greatly to the overall · instability of the locator. Usually, physical disturbances, difficult to avoid during exploration, cause abrupt frequency shifts, thereby masking the sought response. Indeed, despite the continuing controversy over optimum loop size and exploration frequency, the major impediment of detection sensitivity has always been *mechanical and electrical instability*. For this reason, the single-turn loop is, in itself, a worthwhile improvement. Moreover, because of the extremely low impedance of such a loop, no electrostatic shielding is necessary! Thereby, we avoid degradation of sensitivity from the eddy currents induced in a shield.

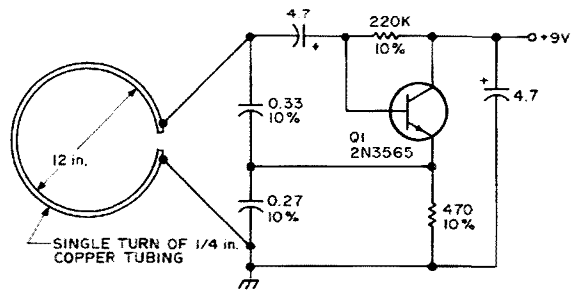


Fig. 3. Loop oscillator schematic. This oscillator is situated directly between the ends of the single-turn loop.

Prelude to Construction

The locator is comprised of three basic functional blocks: the loop oscillator, the fixed oscillator, and the transistor radio. From a constructional viewpoint, we are concerned primarily with the two oscillators. Our involvement with the transistor radio is simply the mechanical one of providing a suitable mounting for it on the handle of the locator. If we are successful with the oscillators, their fields will penetrate the radio and the locator will be operational. So, let us commence with the loop oscillator.

It has already been mentioned that the loop oscillator uses a single turn of copper tubing in its resonant tank. Another unique feature is the physical location of transistor Q1 and associated components. These are

situated on a PC board (Fig. 4) directly between the ends of the loop (Fig. 5) so that we do not have the usual separation between active element and tank circuit. This, too, enhances stability and sensitivity.

The inside diameter of the nearly complete circle of copper tubing is 12 in. Approximately 2 in. of space is allowed between the ends. This space is occupied by the PC board containing the remaining parts of the loop oscillator.

The use of a high-beta transistor and Mylar capacitors results in a sure-fire and stable oscillator in the 450 kHz region, despite the extremely low impedance of the single-turn tank circuit. The tubing should be protected by some type of sleeving ("spaghetti" or heat-shrinkable tubing).

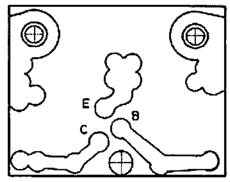


Fig. 4. Loop oscillator (circuit side).

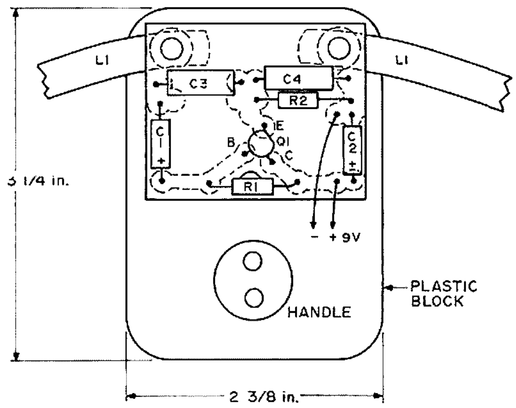
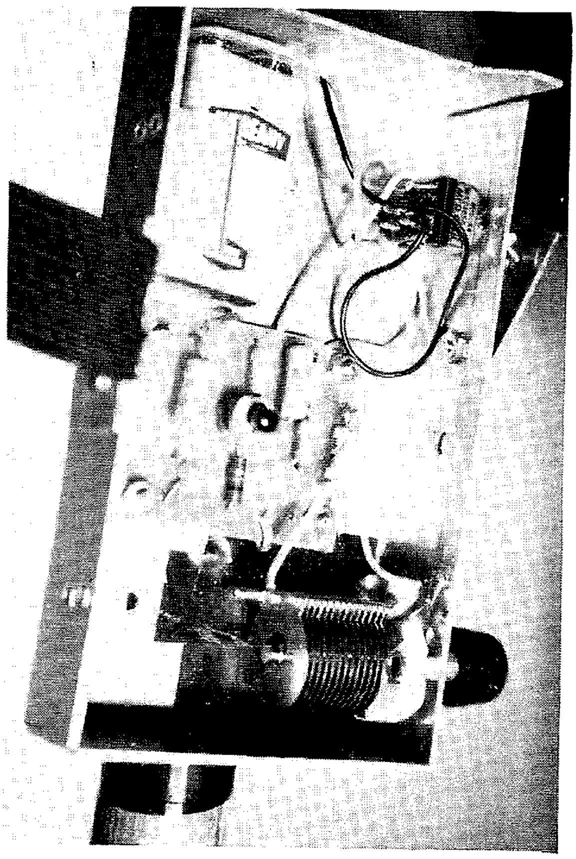


Fig. 5. Mounting block, showing association with loop oscillator and handle.



Reference oscillator — inside view with cover plate removed.

Oscillator

The reference oscillator utilizes transistor Q2 in a Colpitts circuit similar to that of the loop oscillator. A quality air variable capacitor is provided for frequency adjustment. Such a capacitor is *greatly superior* in mechanical and electrical stability to the movable-core inductors commonly used in metal locators. However, relatively small tuning-range results from its use. This is actually desirable from the standpoint of stability. Because the large tuning range associated with a movable-slug inductor is not obtained, it is mandatory that the prescribed components, or their equivalents, be selected both for the reference oscillator and the loop oscillator. On the other hand, the reproducibility of the loop oscillator renders it unnecessary to incorporate a wide tuning range for the reference oscillator. The reference oscillator circuit board (Fig. 6) is situated on the handle, adjacent to the transistor radio. A single 9V battery powers *both* oscillators. As with the loop oscillator, it is very important that *all components be securely*

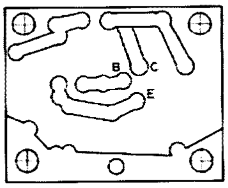
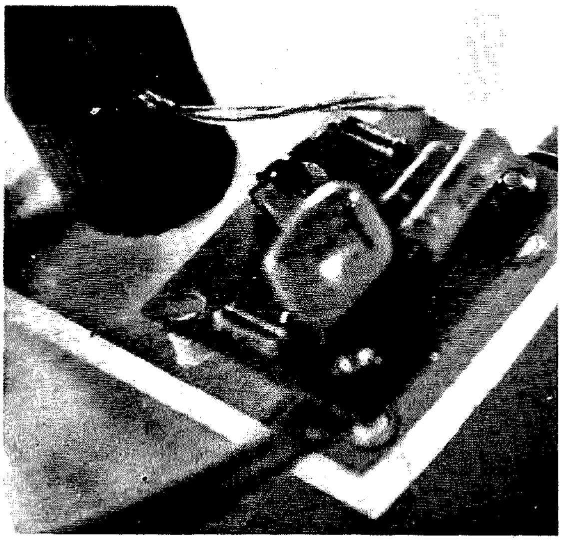
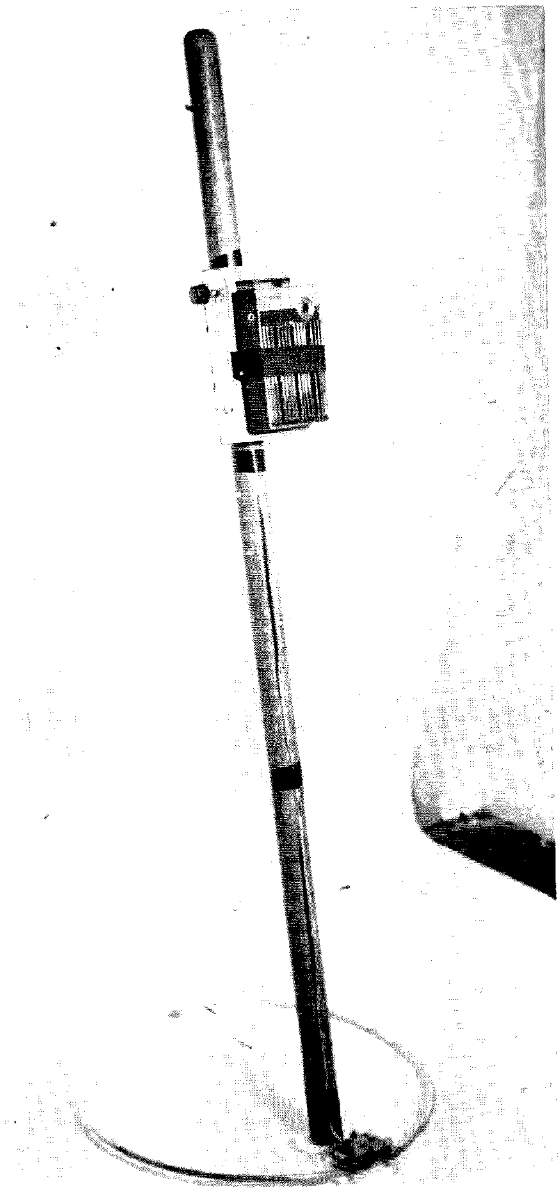


Fig. 6. Reference oscillator (circuit side).

mounted. This requirement tends to "come along for the ride" as a consequence of the printed-circuit board. In the event a different construction technique is used, it should be realized that any relative movement of the components or connecting wires can diminish the usable sensitivity.



PC board and loop ends are attached to clear plastic block. This block also supports the handle. (Speaker cord goes to battery and switch which are contained in the handle-mounted reference oscillator box.)



Transistor radio is strapped to box; a single turn of copper tubing makes the exploratory loop. The novel principle of operation renders unit independent of stations, nondirectional, and highly stable. Overall result is enhanced sensitivity and exceptional ease of operation.

Notes on Operation

Before commencing operation, it is essential that it be understood that broadcasting stations do not play any part in production of the search tone. Indeed, the reception of a station constitutes interference and tends to mask the pitch variation which signifies proximity of a metallic object. Therefore, the radio must be tuned to a spot *between* stations, or preferably set at the extreme low frequency end of its tuning range. In any event, when the loop oscillator and the reference frequency oscillator are within an audio frequency of one another, that audio frequency will be heard over the *entire tuning range of the radio*. Also, there are no directivity effects; neither the pitch nor the amplitude of the tone changes with orientation of the locator until one approaches a metal object with the exploratory loop.

Three modes of operation are possible, depending upon whether the reference oscillator is adjusted slightly above, equal to, or slightly below the frequency of the

loop oscillator. I favor the third-mentioned mode, with the tone adjusted to the 500–1000 Hz region. Then an approach to a metallic object will cause a rise in pitch. This locator is *entirely free* of "pulling" between the two oscillators which, in conventional locators, often causes a marked reduction in sensitivity.

Troubleshooting

If, with the transistor radio strapped to the reference oscillator box, adjustment of the variable capacitor does not bring forth the audio tone, both the reference oscillator and the loop oscillator should be checked for oscillation. This is easily accomplished by means of an oscilloscope. Probe the base of Q1 and Q2; if there is no evidence of oscillation, make a methodical investigation of the connections, the components, battery polarity, etc.

The most probable cause will involve the ability of the reference oscillator to tune sufficiently close to the frequency of the loop oscillator. This could come about if the Mylar capacitors associated with the tank circuits deviate more than the prescribed ±10%. Obtain three capacitors with the following capacities: .01, .03, and .047 μF. Parallel one of these at a time with the .33 μF capacitor in the loop oscillator. Each time tune the variable through its range. (The radio should be tuned to the low frequency end of its range and its volume control fully advanced during this troubleshooting procedure.)

If results are still not forthcoming, remove the additional capacitor and go through a similar procedure by connecting three different capacitors across the upper .0022 μF capacitor in the reference oscillator circuit (Fig. 2). These capacitors should be 100, 330, and 470 pF, respectively.

A considerable frequency range will have been covered by these two procedures, and a loud bell-like heterodyne is certain to be produced if all circuitry is properly installed.

I investigated 12 new 2N3565 transistors for the loop oscillator. All but one proved to be vigorous oscillators. The marginal one was found to have the lowest beta of the dozen; this one showed a beta of 130 for a collector current of 1 mA. All the rest displayed values within the range of 220 to 480.

Additional Notes

The cover plate for the reference oscillator should be made of fiber glass, Vector board, Lucite, or other insulating material. *Metal must not be used.*

Polycarbonate or polystyrene capacitors of the specified tolerance could be used in place of the Mylar capacitors in the tank circuits of both oscillators. However, the metalized versions of any of these dielectrics should not be used.

The fact that no shielding of the loop is required can be readily demonstrated by putting one's finger on the "hot" end of the loop. A negligible change in the pitch of the audio-tone is produced. This, of course stems from the extremely low impedance of the loop. Conversely, it is, as desired, very sensitive to *electromagnetic* disturbance of its resonant frequency.

. . . W6HDM ■

Practical circuit applications using that strange diode: the varactor

by **Bill Mengel**

The varactor is a simple two-terminal device extending dependable operation in the VHF, UHF, as well as microwave frequencies by utilizing the voltage-variable capacitance of a pn junction. The varactor provides a way of tuning circuits, multiplying and dividing frequencies, controlling frequencies, and performing other functions. A varactor, which is a special-purpose junction diode, has been designed to make its junction capacitance useful; it is because of this property of a varactor that capacitance, which is an unavoidable nuisance in conventional diodes, is purposely cultivated into the varactor. The basic configuration for the varactor is shown in the illustration below.

The operating portion of a varactor is in the region where a conventional diode would be considered to be cut off — principally in the region between forward conduction and reverse breakdown. In most cases, the varactor is reverse-biased since in this state it draws a minimum of current, making it essentially voltage-operated. The behavior of the pn junction of the varactor at different applied bias potentials is as follows:

ZERO BIAS — At zero bias, the contact potential is determined by the semiconductor. There is no change in capacitance and no current flowing at this time.

FORWARD BIAS—When forward-biased, high forward current flows as the external voltage applied is in series with the contact potential. The contact potential decreases thus increasing the capacitance.

REVERSE BIAS—When reverse-biased, the external voltage applied is in parallel with the contact potential. The contact potential increases, extremely low reverse current flows, and the capacity decreases.

The property of being able to vary the capacitance by changing the applied voltage enables the varactor to do the work of a conventional variable capacitor many times its size. The capacitance of a varactor varies inversely as the reverse voltage, and directly as the forward voltage. It may also be noted that the capacitance of a varactor also varies nonlinearly. Varactors also have a Q approaching that of air trimmer capacitors, so they could be used in such locations as rf front ends and high-efficiency multipliers as well as other normally sensitive circuits.

The varactor diode by itself is unique in frequency multiplying and dividing. First, the rf signal itself is the only power required to operate the varactor. Secondly,

the varactor, by distorting the input signal develops an output rich in harmonics. Thirdly, a varactor can provide a means of high power output at frequencies normally beyond the limits of present power transistors. In frequency multiplication, it is only a matter of placing a tuned circuit (tuned to the input frequency) on one side of the varactor and placing another tuned circuit on the other side tuned at the desired harmonic. As shown in Fig. 1, the input circuit is tuned to frequency f. The output of this circuit is then fed to the varactor where it is distorted. This distorted output is then fed into an output circuit tuned to frequency f(n)out.

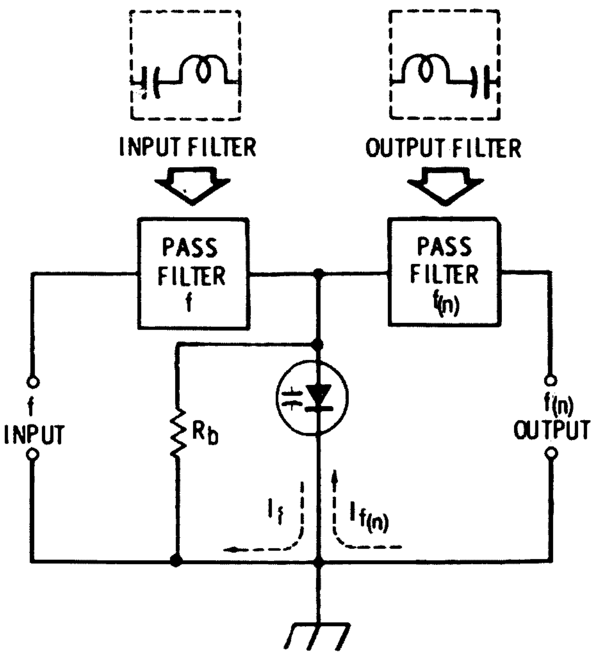


Fig. 1. Frequency multiplication.

In typical frequency doublers, efficiencies as high as 90% — as compared to the 50% efficiency of conventional tubes and transistors — can be realized. This can be attributed to the fact that a varactor dissipates very little power and has low loss. A properly designed varactor multiplier does not generate noise. However, parametric oscillations can occur from highly overdriven varactors or from unwanted

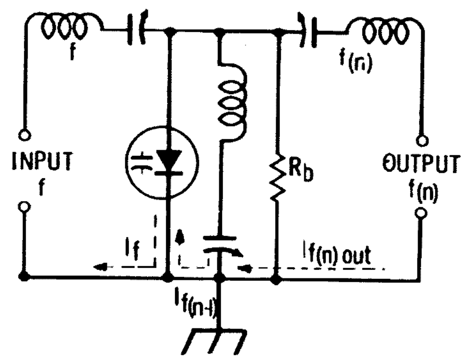


Fig. 2. Postdoubler multiplication.

idler resonances. A bias resistor Rb (shown in the above diagram) will usually have a value of from 68K to 270K. The higher values of resistance make the circuit more efficient while the lower values of resistance make the circuit operate more linearly.

Since average capacitance varies with input power applied, some detuning will occur if the input power to a multiplier using a varactor is changed appreciably. All frequency multipliers beyond a doubler require an idler circuit for maximum efficiency. An idler circuit is used to reinforce the output frequency of a multiplier. This is done in the following manner. The current developed by the idler circuit is added to the fundamental current to form the harmonic current. The tuned frequency of an idler is generally set to one harmonic below the output frequency, as illustrated in Fig. 2.

A basic example will now illustrate the principles of operation of a typical varactor circuit. Our problem is that we want to take a present signal of, say, 150 MHz and develop an output of 450 MHz.

Referencing Fig. 3, capacitors C_2 are used to match the input and ouput of the tripler to the input and output impedances. With an input frequency of 150 MHz, the input filter is tuned to a frequency of 150 MHz. A type 1N4387 varactor is chosen. This varactor is capable of 60% efficiency at 450 MHz (offering a power output of

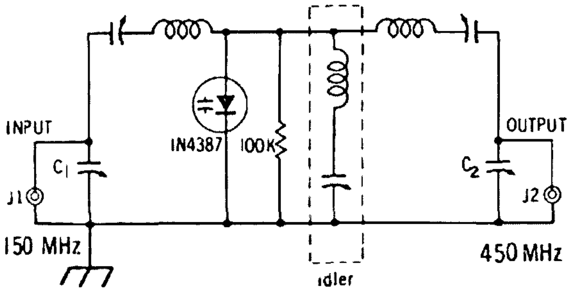


Fig. 3. Varactor tripler circuit.

18 watts with an input of 30 watts). The idler circuit is tuned to one harmonic below the output frequency. In this case the idler should be tuned to resonate at 300 MHz. The bias resistor is chosen as 100K so the circuit will operate linearly. The output circuit is then tuned to resonate at the desired output frequency (450 MHz). After alignment, it is a good idea to repeat the tuning procedure because there is almost always some interaction between stages.

Another use for the varactor is in the development of an FM signal. By rectifying a modulated signal and applying that fluctuating voltage to the terminals of a varactor, we could use the changing capacitance of the varactor to cause frequency deviation of an oscillator. Hence, the development of frequency modulation via the varactor. Also, by properly proportioning the fluctuating audio voltage going into the varactor with respect to the oscillator, either narrowband or wideband FM may be obtained, as shown in Fig. 4.

In the circuit of Fig. 4, a rectified audio voltage is introduced at the potentiometer which can be adjusted to allow the required frequency deviation whether it be wideband or narrowband. The charging and discharging of capacitor C_1 through resistor R_1 applies a fluctuating voltage on the anode of the varactor. This fluctuating voltage will cause the capacitance capabilities of the varactor to vary, thereby pulling the oscillator off its center frequency.

As mentioned earlier, the property of being able to vary the capacitance of a varactor by varying the input voltage enables it to do the work of a conventional variable capacitor. One great advantage as opposed to conventional tuning is miniaturization. A typical varactor for this type of service in most cases is about the size of a small signal diode (1N34, for example) and this is many times smaller than even

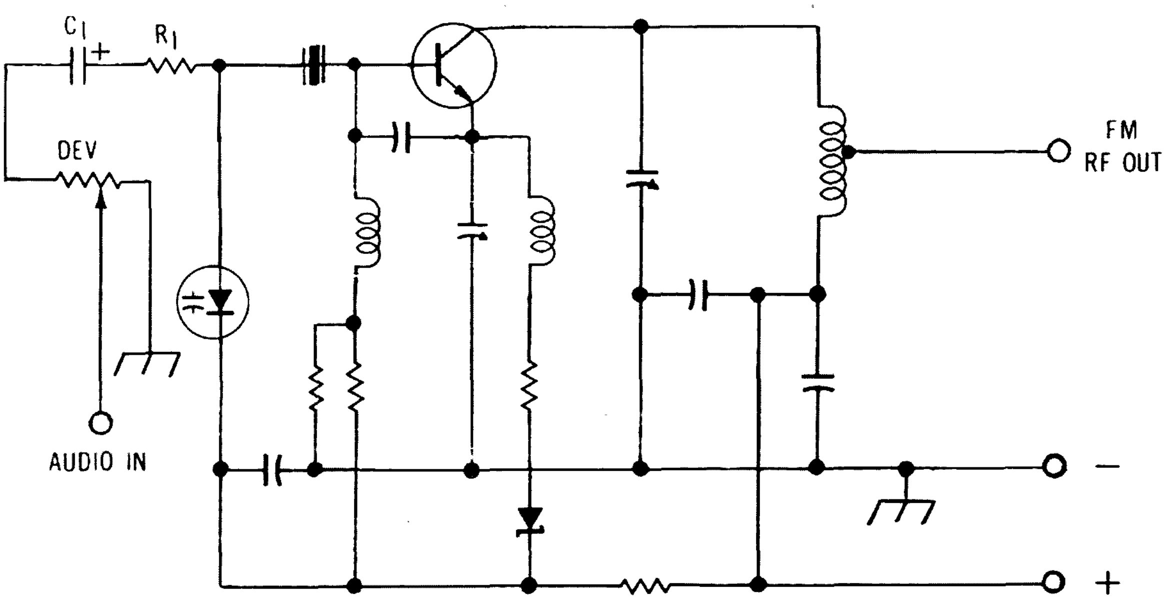
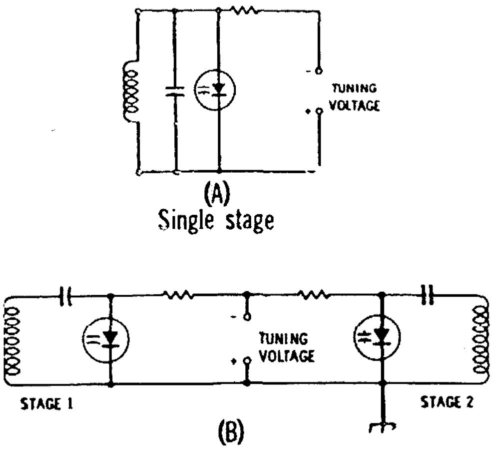


Fig. 4. Frequency Modulation using the varactor.

the smallest variable tuning capacitor. In cases where larger values of varactors are needed than is available, parallel operation is feasible. However, it must be kept in mind that both the minimum and the maximum capacitance capabilities are increased with parallel operation. Multistage tuning that at one time required a large ganged variable capacitor can now be controlled by a single small variable potentiometer by varying the dc control voltage to the varactor. The illustrations of Fig. 5 show a typical circuit using a varactor for tuning along with a circuit utilizing varactors for multistage tuning.



(A)
Single stage

(B)
Multistage

Fig. 5. Varactor tuning.

In the case of an FM receiver, a varactor can be utilized to regulate the amount of drift of the local oscillator by compensating for that drift and, in a sense, locking it on frequency. This type of circuit is commonly known as automatic frequency control or simply AFC.

What occurs in a typical AFC circuit (Fig. 6) is this: A correction voltage developed in the discriminator circuit is directed to a varactor through a filtering network. Any error in tuning will result in a voltage change at the discriminator and it is this change that is used to alter the capacitance of the varactor to compensate for that

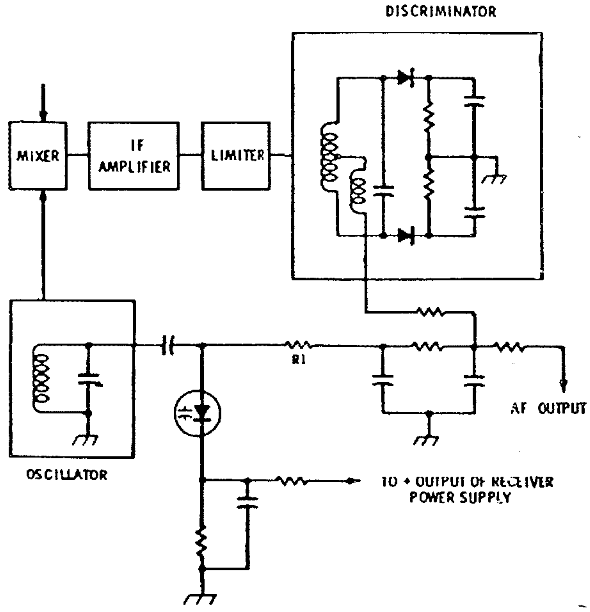
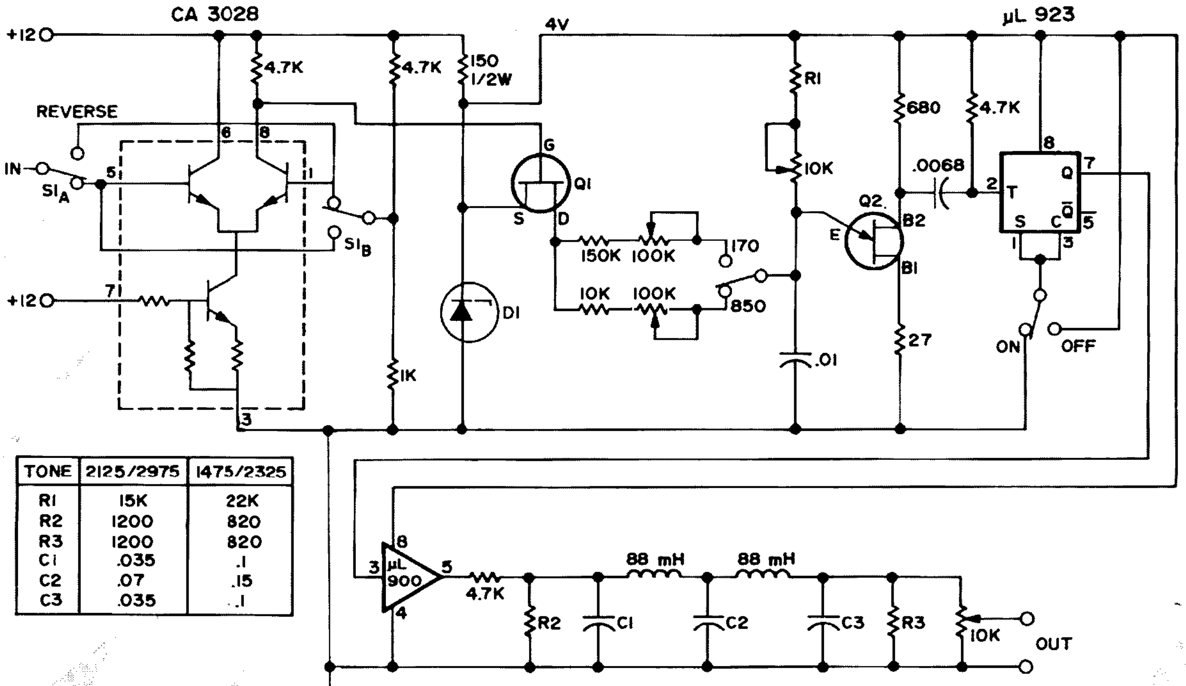


Fig. 6. Varactor afc circuit.

error. This changing capacitance is then used to complement the final tuning of the oscillator to lock it on frequency.

The possibilities of a varactor in communciations applications are almost limitless. Scan-tuning, a technique that once required many complicated circuits, is now simplified by a varactor: With scan-tuning, band sweeping is accomplished by applying a fluctuating voltage from a sawtooth oscillator. The sweeping rate is then predetermined by the frequency of that sawtooth oscillator.

This article just briefly illustrates how the varactor, a comparative newcomer to the field of semiconductors, opens the door to simplifying and improving many different types of electronic circuits. . . .Mengel■



TONE	2125/2975	1475/2325
R1	15K	22K
R2	1200	820
R3	1200	820
C1	.035	.1
C2	.07	.15
C3	.035	.1

Fig. 1. Circuit diagram for the AFSK unit.

A clean AFSK unit

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When it came time to put my new SSB transmitter on RTTY, it was apparent that using the microphone pick for AFSK input was the most desirable method. While there are dangers in this method concerning noncompliance with FCC regulations regarding purity of emission, it was decided that the advantages of being able to use the VOX circuits for switching and being able to transceive on RTTY would make this approach worthwhile. Since the transmitter uses a steep-skirted bandpass filter, it was felt that such a system could yield good results. Indeed, the method of CW generation is introduction of an audio tone into the audio stages.

After conducting a search of the available literature, the following list of desirable qualities for an AFSK circuit was made:

- Negligible harmonic generation
- Freedom from keying transients
- Ability to reverse shift
- Equal mark and space amplitude
- Wide and narrow shift capability
- Ability to use low and high frequency tones
- Easy to build and align

Of all the circuits examined, only that designed by K3NIO and described by Irv-n Hoff[1] appeared to meet all of the first five criteria. Unfortunately, this design did not give information for using this unit on the low-frequency tones required by most of the transmitters that are adequate for this mode of FSK generation. The circuit is somewhat more complex to build than most of the AFSK units now in use, which may have discouraged its construction by many amateurs.

As a result of this analysis, I came up with a new circuit (Fig. 1). Construction may be simplified by the use of a printed-circuit board. The use of inexpensive integrated circuits further simplifies construction. Information is given for use with 2125/2975 and 1475/2325 Hz tone pairs. The latter tone pair was chosen as optimum from the

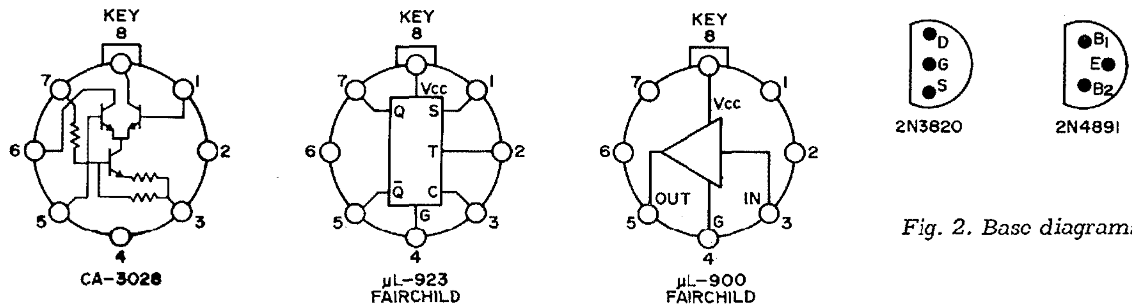

Fig. 2. Base diagrams.

standpoint of minimizing spurious signal generation in a transmitter with a 2.1 kHz bandpass filter.

Circuit Description

The basic scheme of frequency generation for this circuit is the same as that designed by K3NIO. A free-running unijunction transistor multivibrator is used as a frequency-shifted pulse generator running at twice the desired frequency. This pulse train is divided by two in an IC Flip-flop, forming a constant-amplitude square wave of the desired frequency. The square wave is then filtered in a five-pole Butterworth low-pass filter which suppresses all odd harmonics above the fundamental frequency (even harmonics are not present in a square wave). The frequency of the oscillator is shifted by switching an additional resistance from supply voltage to the emitter of the unijunction. This provides more charging current to the capacitor and results in a higher-frequency pulse train. The actual switching is done using a P-channel FET as a switch to achieve the very high *off* resistance necessary for easy adjustment of the shift. The FET is driven by a differential amplifier which senses the keying loop circuit. This diffamp is used as a current-switching discriminator and allows us to reverse shift very easily by interchanging the input leads. The switching threshold is approximately +2V at the input, which may be conveniently obtained from the TTY loop supply current passing through a series resistor.

The power supply (not described here) is merely a single-ended 12V supply. Regulation is not particularly critical, and the current drain is only 55 mA.

Construction

The AFSK unit, with the exception of power supply, frequency determining potentiometers, and input coupling circuit, is built on a plug-in printed-circuit board which should be available from the Harris Co.[2] Pay particular attention to align the key on the semiconductor components with the key on the circuit board and you can't go wrong. If you are not using the printed board, pay close attention to the basing diagrams given in Fig. 2. The 88 mH coils are the surplus telephone loading toroids and are readily available at very reasonable prices.[3]

Since reversing shift is not normally done after initial installation, the switch for this function may be omitted if desired. In my own unit, the plug-in socket was wired so that turning the board over in the socket reverses the shift.

Alignment

After applying power to the unit from a suitable source the *operate/standby* switch should be put to "operate." With the reversing switch in normal, the 25 kΩ potentiometer should be adjusted for the low tone. Next, apply approximately 4V to the input. A jumper from the cathode of the zener to the input will do. Now adjust the 100 kΩ potentiometers for the narrow and wide shift high tones. That's all there is to it!

Keying circuit

The keying circuit in use at my station is shown in Fig. 3. Many other schemes can be used; however, they should be examined to make sure that they will not place over 6V on the input of the differential amplifier. If in doubt, my own simple protection scheme is good insurance.

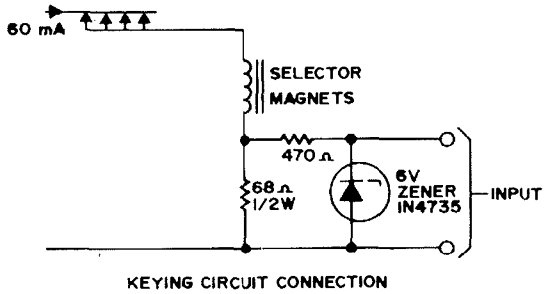

Fig. 3. Keying circuit connection.

Conclusions

This AFSK unit represents an advance over many other desigs which have been offered. Its freedom from keying transients and harmonic generation should help clean up some of the signals heard on the band presently. The presentation of a design for the lower tone pair should allow use with many transmitters without modification. Economy semiconductors and integrated circuits are used, and the cost of building the unit with all new parts should be about $10. Certainly a clean signal is worth that! If you like your circuits "ready printed," you can send a $2.50 check to American Photo Etch Co., Box 2627, South San Francisco CA 94080. If you'd rather do your own, check the board and component layouts in Figs. 4 and 5.

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2. *Harris Company, 56 E. Main St., Torrington CT.*

3. *Elliot Buchanan Assoc., 1067 Mandana Blvd., Oakland CA.*

. . .WB4FMP■

An SSTV Patch Box

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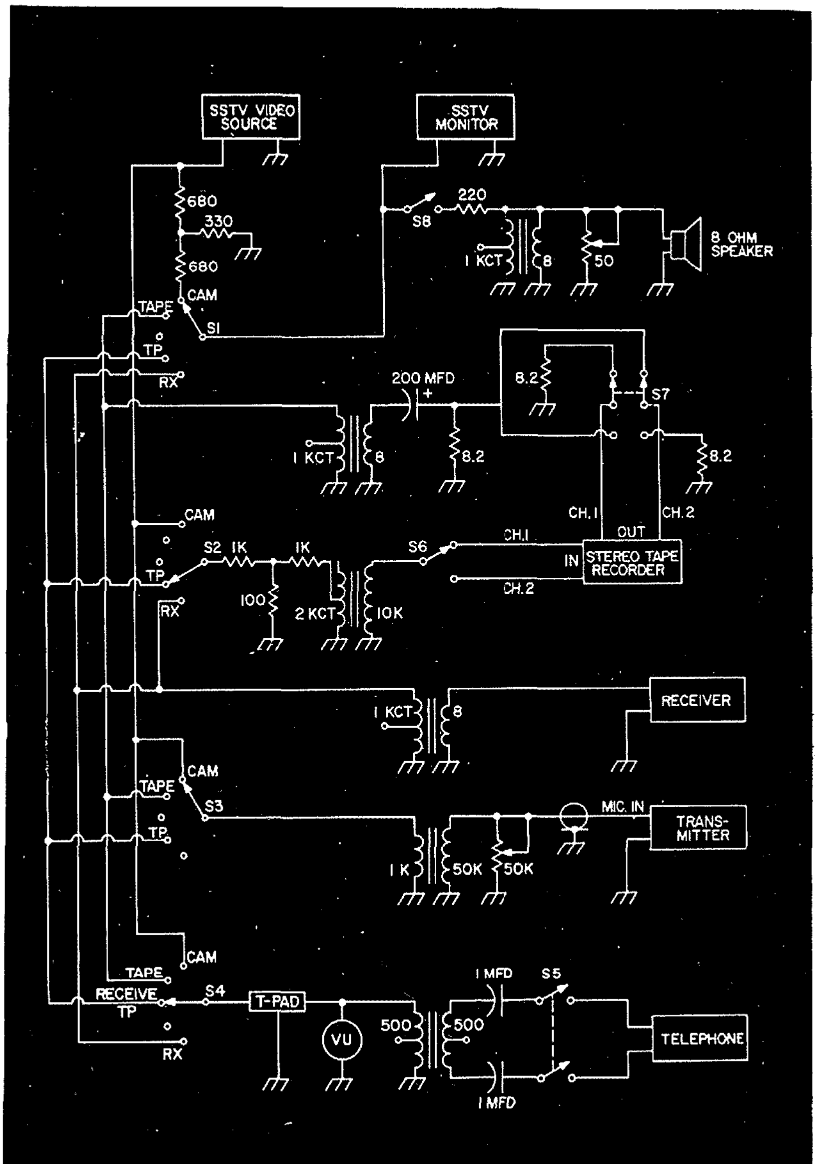


Fig. 1. Patch box schematic.

The subcarrier FM slow-scan television (SSTV) standard most widely adopted in the United States (Macdonald, 1961) permits SSTV equipment to be used with any device designed for the audio frequencies. Thus, a basic SSTV system consisting of a monitor (Macdonald, 1964; Cohen, 1967) and a video source (Vidicon camera: Macdonald, 1965; Taggart, 1968; Hutton 1969; Flying Spot Scanner [FSS]: Hutton 1967; Pattern generator: Hutton, 1969) can be used, and often is used, in conjunction with a communications receiver, transmitter, audio tape recorder, and telephone. With the possibility that six or more pieces of equipment may be involved in SSTV operations at a given station, a requirement exists for a versatile, efficient means of interconnecting the various equipment inputs and outputs. The slow-scan TV patch box described below is designed to provide this patching capability. While in principle similar to the SSTV switching network described by Taggart (1968), this patch box includes:

1. provisions for patching signals between a monitor, video source, communications receiver, transmitter, two-channel (stereo) tape recorder, and a telephone;
2. a phone patch and attendant meter for signal level monitoring;
3. inter-stage transformer coupling; and
4. background audio monitor.

General Comments

The patch box schematic is given in **Fig. 1**. The author's unit, built in a Bud "Porta-cab" (Model WA-1540) is shown in **Fig. 2**. For efficient interstage coupling, transformers are used between the major system elements. The input/output impedances characterizing equipment at the author's installation are shown in **Table I**, together with the transformers employed.

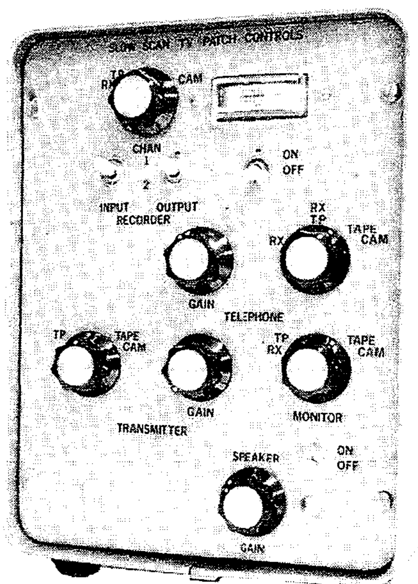
Transformers chosen represent a compromise between the characteristic impedances of the various pieces of equipment, and the design factors of the high-quality, inexpensive line of Argonne transformers.

Wiring is noncritical, though shielded audio cable should be used for the lead to the transmitter's microphone jack. All switches, gain controls, and the VU meter are mounted on the front panel; the transformers, fixed-value T-pads, and speaker are mounted on the top of the subchassis (Bud, AC-402; see **Fig. 2**). All input/output leads (except those for the telephone) terminate in jacks which are mounted on the rear panel of the subchassis. The RCA phono jack was chosen as the patch box standard, not only for its small size, but also for its widespread application in audio equipment. Bypass capacitors are recommended for each input and output jack; these capacitors (.001 to .01 μFd) should be mounted at the jacks. with leads kept as short as possible. In cases where severe rf feedback is encountered, rf chokes may also have to be installed in the input/output leads.

The patch box is completely passive. Thus, no power source is required.

Table I. Characteristic impedances and transformers employed.

EQUIPMENT	INPUT IMPEDANCE	OUTPUT IMPEDANCE	ARGONNE TRANSFORMER
Video source	----------	1K	----------
Monitor	600	----------	----------
Tape recorder			
Channel 1	10K	8	IN: AR-109 (10K: 2K CT)
Channel 2	10K	8	OUT: AR-137 (8.1K CT)
Telephone	600	600	AR-162 (500 CT:500 CT)
Receiver	----------	8	AR-137
Transmitter	50K	----------	AR-129 (50K: 1K)
Background monitor	8	----------	AR-137



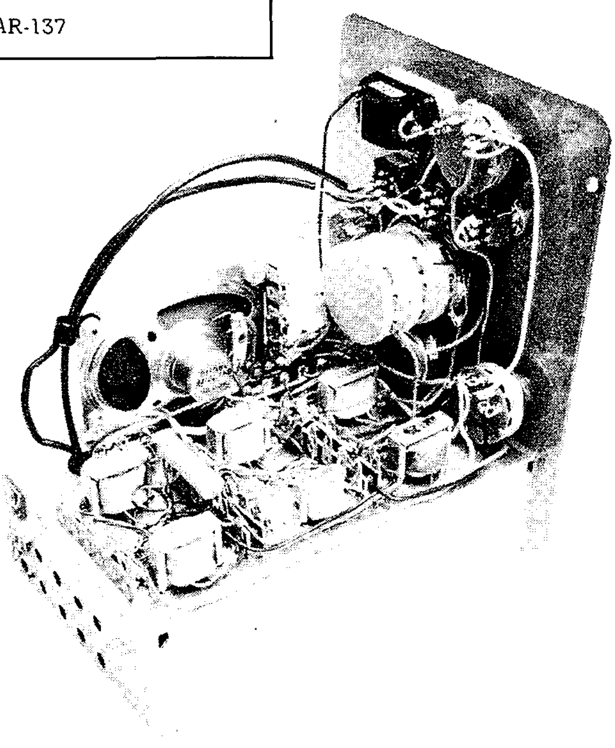


Fig. 2. Front and interior views of patch box. Extra RCA phono jacks are provided on the rear panel for multiple outputs (if desired).

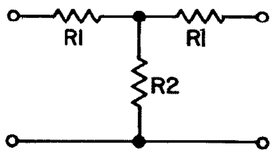


Fig. 3. Generalized diagram — T-pad attenuator.

Circuit Details

Though the logic behind the design and operation of the patch box is largely self-evident, a number of comments are warranted.

The output of the author's vidicon SSTV camera is slightly over 3 volts RMS. This is considerably larger than that required to drive the monitor's FET input amplifier. Thus, a T-pad attenuator (**Fig. 3**) is inserted between the camera and monitor, here designed to reduce the input voltage to the monitor by a factor of 6. To protect the tape recorder's input circuits, all recorder inputs are attenuated by a factor of 20. As T-pads other than those used here may be required, design criteria for the T-pads are given below:

Let $k = E_{in}/E_{out}$, and define Z to be the characteristic line impedance. Then:

$$R_1 = \frac{Z(k-1)}{(k+1)}$$

$$R_2 = \frac{2Zk}{(k^2-1)}$$

Phone patches used in SSTV communications rarely need be more complicated than that shown in **Fig. 1**. Two 1 μFd high-quality (Mylar) capacitors provide for dc isolation and line balance. The transformer provides a single-ended line to the patch box, and a balanced line to the telephone. A conventional audio T-pad (IRC TP500A, Mallory T500 or T600) is used to set the telephone line level, this level monitored on the inexpensive VU meter provided.

As shown in **Fig. 1**, SSTV signals are fed directly to the transmitter's microphone input. Examination of **Fig. 2**, however, will show that panel space is available (lower left) for a switch and microphone jack. Installation of the switch and jack as shown in **Fig. 4** further enhances the versatility of the patch box, allowing the operator to choose easily between video and live oral signals.

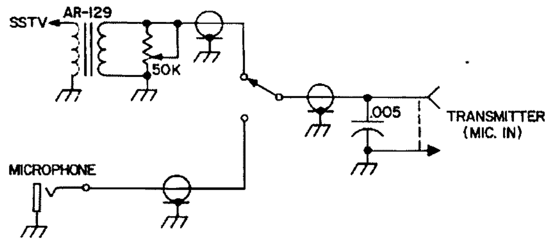


Fig. 4. Alternate SSTV-microphone input circuit. The switch and microphone jack may be mounted on the lower left portion of the front panel.

To protect the tape recorder's output transistors, an 8.2 ohm resistor is automatically switched into the unused channel's output. Additional protection of the tape recorder's output circuitry is assured by using the minimum playback gain required. Subcarrier FM SSTV is a constant-level mode, and unless playback gain is minimized, output transistors and transformers will overheat and be destroyed. To protect the tape recorder during SSTV recording sessions, place the recorder selector switch in the PAUSE or RECORD position only when you are about to record. Further, the individual recorded segments should be kept short. For practical reasons, an SSTV picture is usually not repeated more than 10 times (most SSTV'ers get bored after viewing the same picture twice). Thus, with the 8-second frame period employed, a typical recorded segment should be less than 1½ minutes long. Most tape recorders will handle a constant-level input signal for this period of time.

Conclusions

The patch box described has been in use at the author's station for over two years. During that period, it has been found to greatly facilitate tape record and playback sessions. Further, it has proven indispensible for local SSTV operations where the camera, monitor, tape recorder, and telephone are frequently employed in various combinations.

Those desiring further information on slow-scan television are referred to the liter-

ature in *73*, *QST*, and *HR*. You are also invited to join one of the many slow-scan groups which meet near 14230 kHz, Saturdays, at 1900 GMT (1400 EST). The author can usually be found by contacting W4ABY or K6BL/4.

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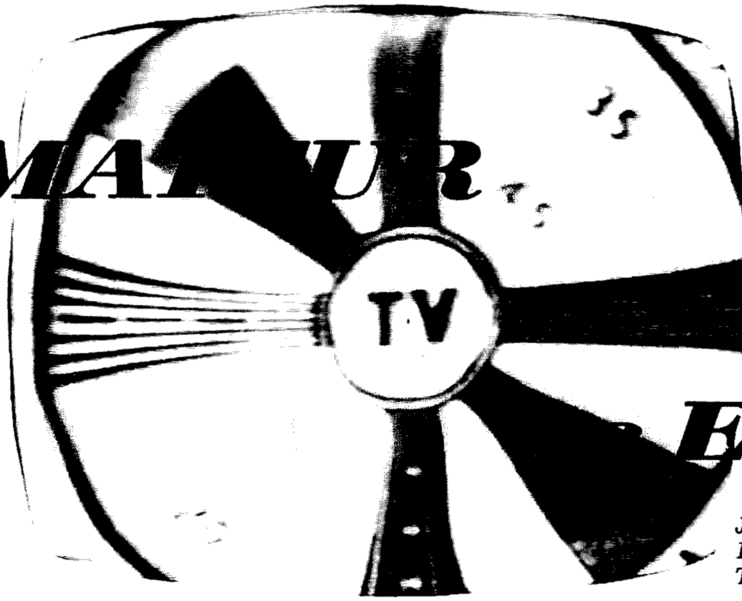
. . . W4UMF

AMATEUR TV EASY



Jim Zimskind K2OJL
108 Kensington Avenue
Trenton NJ

CQ, CQ, CQ, this is K3FEN, Richboro, Pennsylvania, beaming northeast, calling CQ, monitoring 439.25 FM and by for a call.

K3FEN, this is K2OJL – pix looks good, Taylor, go ahead.

Well, well, well, good evening, James, thanks for the call. Excellent pix tonight, as usual, but take the camera off that Playboy Bunny . . .No – on second thought, leave it where it is!

Sound far-fetched? Think it's a pipedream that can't be accomplished except by hours and days and months of complex technical effort? Not so! To make an ATV QSO as commonplace as a 2 meter QSO, a couple of days of effort and 100 bucks will get you on the air, with darn good pix and sound, and with the ability to transmit and receive over a range of about 50 miles. I should add that here in the greater New Jersey–New York area we now have a number of stations, all with pictures and reasonable strengths who enjoy nightly ATV QSOs. And they're all having a ball doing it.

I had been contemplating TV at this level for 15 years, and with what seems like a bare minimum of work, really fantastic results were achieved. There just wasn't all that complexity to it.

Basic requirements for completing TV stations are:

(1) Lots of enthusiasm.

(2) Lots of cold beer.

This article is intended to stimulate interest and subsequent operation of this beautiful mode by those who already have thought about it and were not really aware of new stations on the air.

I could discuss how much pleasure we have all derived from looking at one another as well as talking to one another. But I hope you will discover this for yourself. We have 18 stations, an outgrowth of four original anchormen who coerced, enticed, and frankly used bigger hammers on the heads of the skeptics . . .who otherwise would be calling their heads off trying to raise Aunt Zelda on the five-meter band.

Well, I hope I have elicited your interest, because now we come to the main purpose of this article, which will be my attempt to illustrate the most economically feasible way to insure your success on A5.

After a year or so of playing with various combinations of antennas, preamps, converters, receivers, cameras, transmitters, video modulators, rf amplifiers, I have arrived at what is a simple and effective station setup, easily afforded by the average ham, and easily put together into a working system. Let's divide the station into three basic systems: receiver, transmitter, and antenna.

Antennas

Good reliable reception and transmission at 440 MHz requires a high-gain, wide-bandwidth antenna. Most of the fellows are using the new Cushcraft 20-element DX array in combinations of

20, 40, or 80 elements at heights of 50–80 feet, fed with low-loss coax which matches the antenna impedance of 50Ω as well as the output of a 50Ω transmitter. Large-diameter "hardline" (available from Deane Kidd, K7ZIR, in Beaverton, Oregon, in 55 ft coils at a cost of $20) exhibits a loss of less than 0.5 dB at 450 MHz. It is waterproof, conforms to any structure, can be bent and filled with bottled gas to eliminate moisture. RG-9 is also good at these frequencies, slightly better than ordinary RG-8, which will exhibit approximately 5 dB loss per 100 ft.

As the video portion of the signal must be 10 dB above the audio, for best results, I urge that you obtain the best coax you can, terminating preferably with Type N or BNC fittings at every point in the system. Though almost any antenna will work, I recommend the collinear because of its reliable gain and bandwidth. Remembering Sam Harris' adage, "If your antenna didn't fall down last winter, it wasn't big enough," I suggest that the bigger and the higher, the better.

Transmitters

Probably the easiest way to get on TV is by converting a 450 MHz commercial FM transceiver, such as an RCA CMU-10 or 15, using 5894s in the final, a GE "Pre-Prog," or a Motorola T-44 (both with 2C39s). These units are available complete with receiver, transmitter, crystal ovens, and dc power supply for around $35.

Tuning the transmitter is not much more complicated than obtaining a crystal for the frequency you desire to work. Here in the tri-state area of New Jersey, New York, and Pennsylvania, we are using 439.25 MHz. It is a reasonably simple matter to adjust the various stages in the transmitter with the help of a VOM, which will plug right into existing test points. The tuneup procedure involves about a half-hour of time.

Once you have obtained approximately 15W of rf output from the strip, all that remains to be done – and don't let it scare you – is building the video modulator. W6QUI has designed an excellent two-transistor video modulator which can be built at a cost of approximately $10, including a printed circuit board available from Tom O'Hara (W6ORG) at a cost of $3.50. It uses only a handful of solid-state components and has been found to be capable of reliably modulating the 2C39 final. Simply run a lead (the shorter the better) from the output of the video modulator to the grid of the final, and apply 100V dc (regulated) to the video modulator.

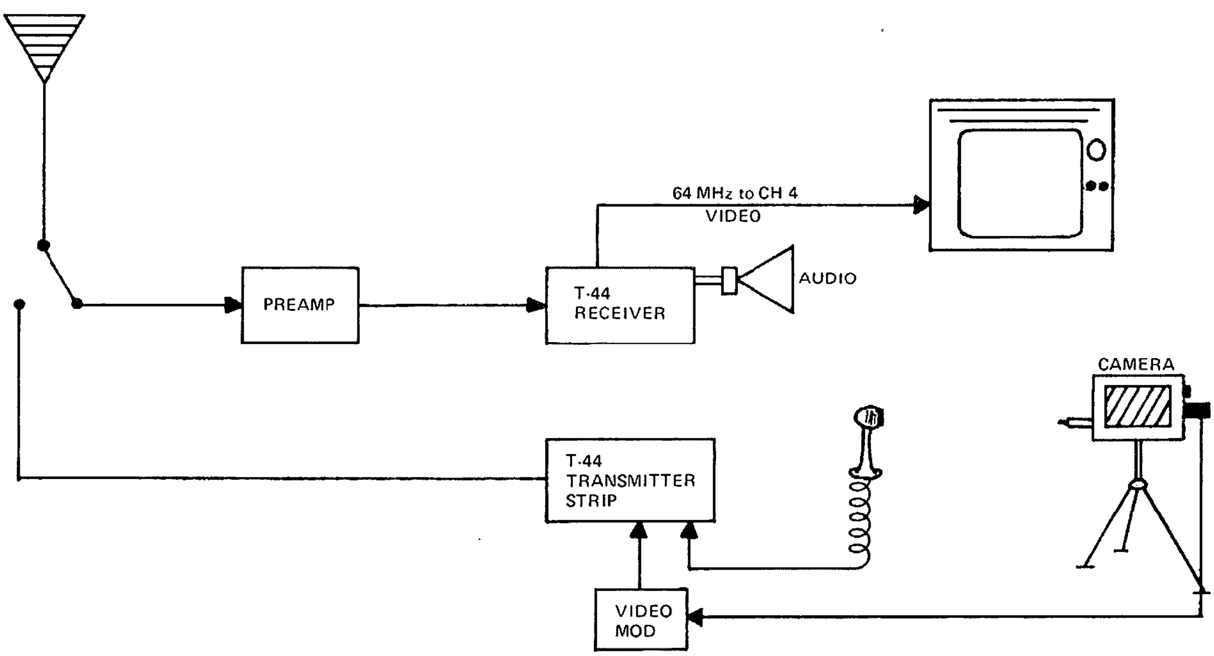
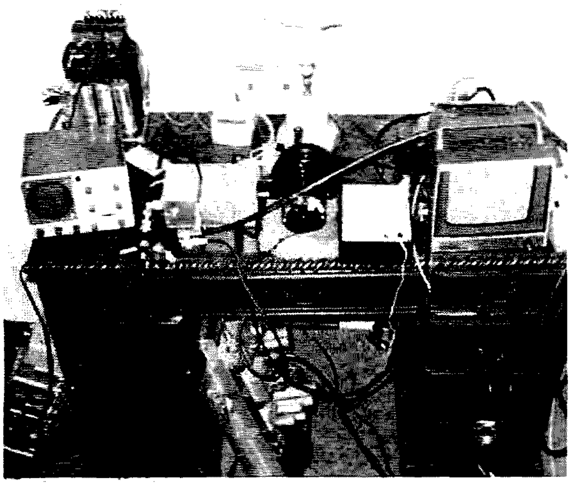


Fig. 1. This block diagram shows the true simplicity of a typical ATV station.



Messy and mickey mouse, but when all the jumper wires are connected and the zip-cord extensions are plugged in, it really works.

All that remains to complete the transmitting side of the stage is a camera. TV cameras are available from many sources and range in price from approximately $50 for a used Jap camera, to $300 for a new one, and $100 to $1000 for a good-quality U.S.-made type. All of the modern small transistor cameras produce enough peak-to-peak voltage to drive the modulator (about 2V).

After you have the system on the air and are monitoring, it's a good idea to sample some of the rf through a video detector, coupled to either a scope or a video monitor so that you can watch the off-the-air picture as you play with the beam control on the camera, the video modulator gain control, and the tuning controls on the transmitter. This will insure that you are watching the actual picture you are transmitting, rather than an overloaded TV set which will tend to distort the picture.

Incidentally, just connect a carbon mike to the microphone input on the transmitter, as the strip serves for both FM and AM, the function of transmitting video and audio simultaneously on the same frequency. The separation of audio and video is done at the receiver.

Receiver

The receiving setup is even easier to organize and get working, particularly with GE or RCA receiver strips. Very simply, it's just a question of obtaining a crystal at the proper frequency, plugging it into the crystal oven, applying voltage, and tuning the various stages for best received signal, or by letting anyone with a frequency meter and a signal generator tweak each stage for maximum. *Ed. Note: T-44s can be a pain, though. Even though they're probably the best performance-wise, you may have a tough time getting the right crystal. Some T-44s use a 10 MHz crystal, others use a 30 MHz rock. And the actual crystal frequency will depend on the frequency of the second oscillator, which varies from unit to unit.*

A nice feature of the Motorola is that its receiver strips have an i-f output at 64 MHz, and through a coupling capacitor and with a small piece of coax (72Ω) you can pump this signal into channel 4 of any TV set and get good resolution and gain. A balun at the TV set antenna terminals will transform the unbalanced 75Ω up to 300Ω balanced, to match the TV tuner. This system will allow you to use the squelch already on the receiver strip so that with your TV set off, you can always hear an ATV'er break the receiver.

Incidentally, you can use the transmit–receive relay already incorporated in the transmitter strip, for one-switch operation or push-to-talk, as you like.

So, there it is, and inexpensive, reliable amateur TV system that many fellows are using, and with which they are having the time of their ham radio lives. My own future plans call for color transmission with stereo sound and the use of video tape. A repeater is now being built which will serve the three-state area – so, as you can see, the action is there. All you have to do is get in on it.

Any of the ATV'ers would be glad to demonstrate their equipment in operation as well as give you a hand with any problems you may incur.

Don't let this article be just another thing. Go out and get the parts, put it together, and make it work. Then you will be able to get a good look at my secretary, WB2PQZ. She's an avid ATV'er herself and a real doll . . .and she will be glad to give you a demonstration.

. . . K2OJL ■

A Tuning Indicator for RTTY and FAX

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The tuning indicator shown in Fig. 1 operates directly from the receivers audio output. It can be used "as is" if audio is taken from the high impedance phone output of the receiver. If a low-impedance speaker output is used then an 8Ω/10 kΩ step-up transformer will be required to insure an adequate signal amplitude at the grid of V1.

An inexpensive two-shadow "tuning eye" tube is used. One plate tunes in mark for RTTY or *white* in the case of FAX. The other plate tunes in space for RTTY or *black* for the other mode. Two sets of filters are used using either 88 mH toroids or 100 mH television-type inductors. The FAX filters are resonant at 2300 Hz (white) and 1500 Hz (black) respectively. RTTY filters are tuned to 2125 and 2975 Hz. An additional 2295 Hz filter ins included for tuning in narrow-shift RTTY.

Filter tuning is most critical of course and should be within a few hertz. You can either purchase the tuned filters from hams engaged in the business or tune your own if equipment is available. If you decide to tune the filters, a frequency counter, stable audio oscillator, and high-impedance electronic voltmeter with good frequency response is required. The equipment setup is shown in Fig. 2. 1 MΩ resistor is used between the oscillator and the tuned circuit under test to insure that a high Q is maintained.

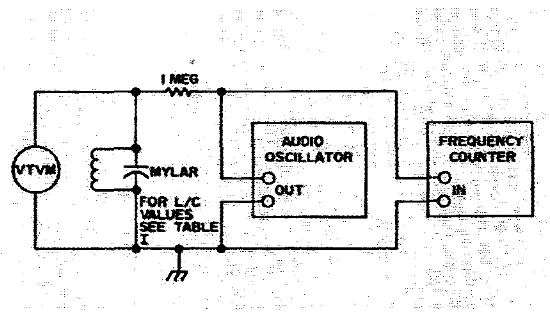
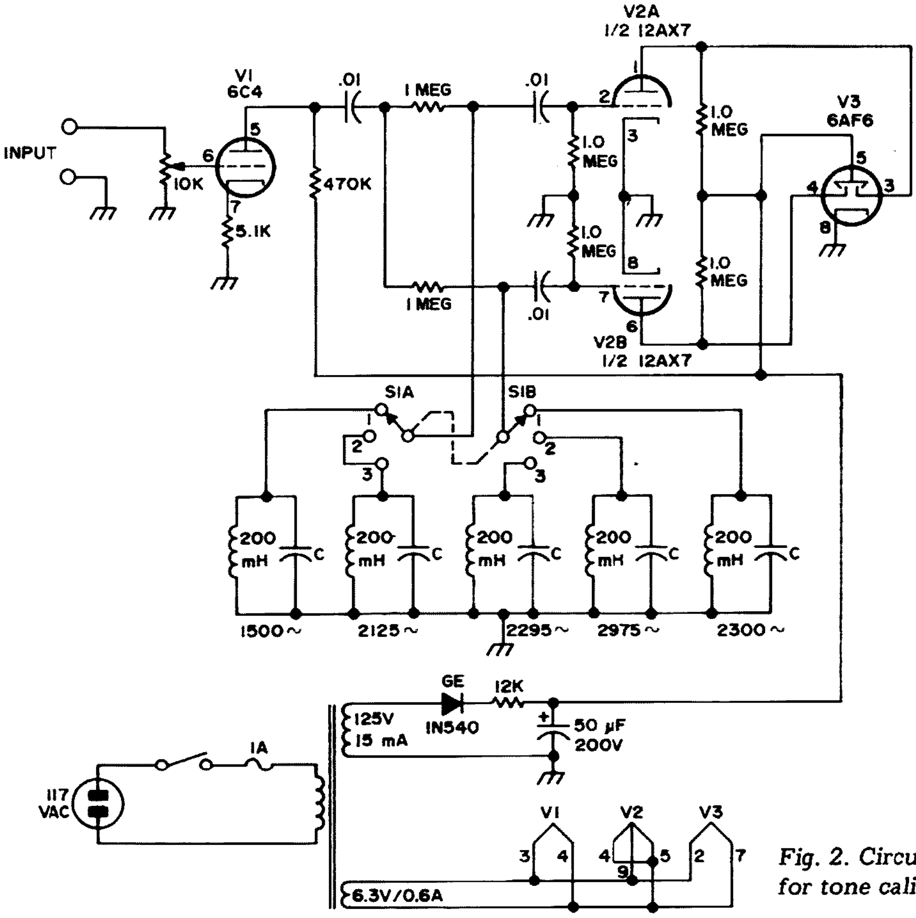


Fig. 1. Double-eye tuning indicator.

Most audio oscillators have a fairly low-impedance output (on the order of 500 Ω) which would decrease the Q of the tuned circuit. As a result, the tuning would be broad. The capacitor (Fig. 2) should be a high-grade Mylar type. Tolerance of the capacitor is not critical since tuning will depend on adding or subtracting turns



S1–D.p.t.t.	
SWITCH POSITION	MODE
1	FAX
2	WIDE SHIFT
3	NARROW SHIFT

Fig. 2. Circuit and equipment setup for tone calibration.

from the inductor or varying the tuning slug if a 200 mH TV width control is used.

Table I shows capacitor values for 88 and 200 mH inductors. Set the audio oscillator to the desired filter frequency with the aid of the frequency counter. Vary the oscillator amplitude until the voltmeter (ac scale) indicates an arbitrary voltage. A low-amplitude output from the oscillator is preferred to minimize the possibility of saturating the inductor. Tune the filter for a maximum indication on the voltmeter. This insures parallel resonance.

Because of the high Q of 88mH toroids it might be necessary to swamp it with a low-value resistor, allowing slightly broader tuning. TV width coils if used, are broad enough, making the resistor unnecessary. However, if 88 mH toroids are used, place a 150 Ω resistor in a series with one leg of each inductor. If the filters are too sharp, stations with shifts slightly divorced from the standard will be out of the bandpass and not received. The described technique can also be used for tuning RTTY demodulator filters.

When an RTTY station is received and the receiver is tuned to mark (2975 Hz), one of the tuning-eye shadows will close. A space signal will close the other shadow. The white or black transmission from FAX

Table I.

Frequency, Hz	L, mH	C, µF
1500	88	.125
2125	88	.068
2295	88	.047
2300	88	.047
2975	88	.033
1500	200	.047
2125	200	.022
2295	200	.022
2300	200	.022
2975	200	.015

(2300 and 1500 Hz) will close its respective shadow. Shadow width is controlled by the 10 kΩ potentiometer which varies the grid drive at V1.

It will be found that the indicator is an adjunct to any RTTY or FAX demodulator. . . . W1OER■

2 SIMPLE TONE UNITS FOR REPEATER USE

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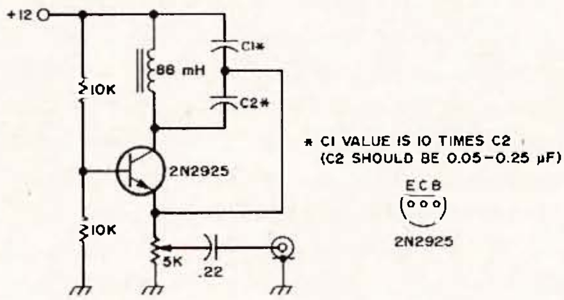
Being quite active on two meter FM, I've recently felt a need to add some versatility to my setup by installing a remote control system from my mobile to base station. The circuits I came up with are extremely stable and reliable through wide temperature and voltage variations. The encoder and decoder are equally usable for subcontrol of conventional tone-controlled in-band repeaters.

Encoder

The encoder is a standard LC feedback type, and is as stable and accurate as the quality of the components used in the collector circuit. I used a standard 88 mH toroid for the inductance, and then figured out C_1 and C_2 from $f=1/(2\pi\sqrt{LC})$ where f is frequency in hertz, L is inductance in henrys, and C is capacitance in farads. The capacitors are in a ratio of 1:1 to get a high Q, so after arriving at $10(C1)_2/11(C1)=C$



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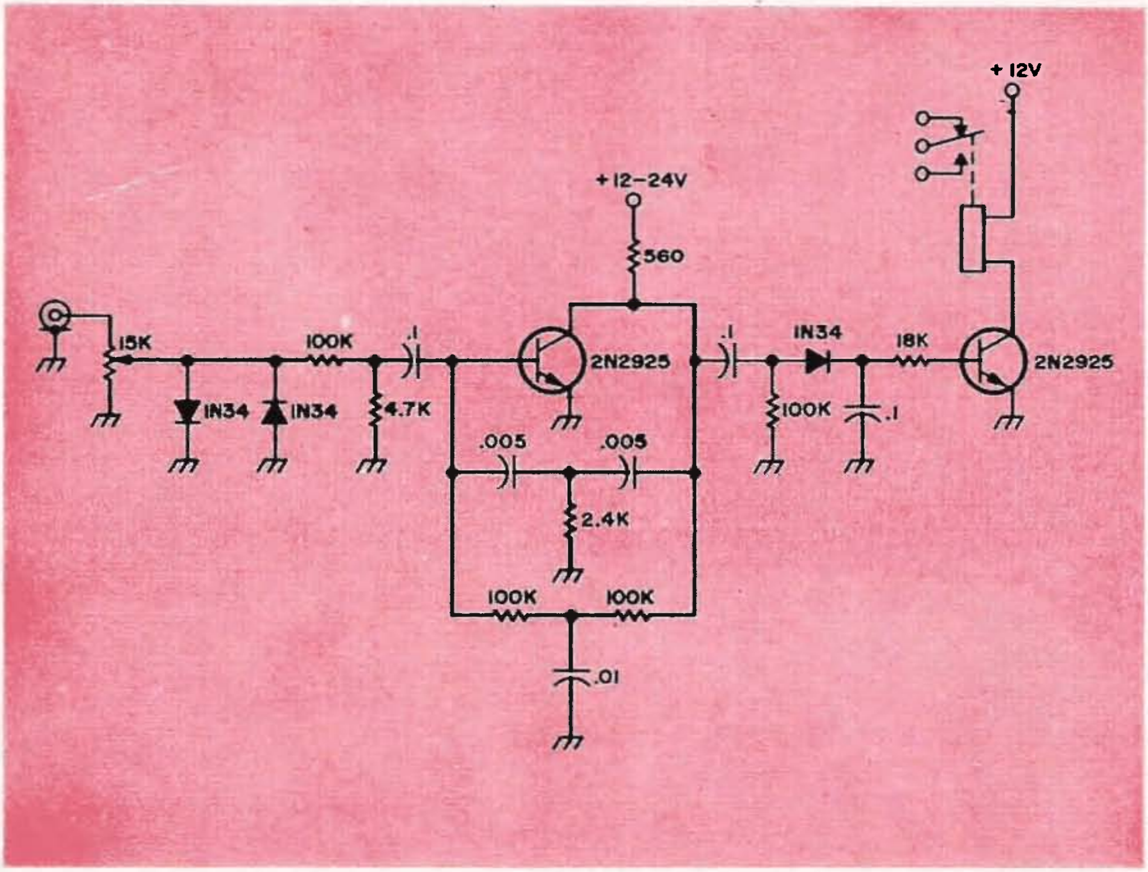

to get the value of C1, then multiply the result by 10 to determine the value of C2. For those who are mathematically lazy, 88 mH, 2 μF and 0.22 μF will give you approximately 1000 Hz. Use at least 10% mica capacitors for C_1 and C_2; otherwise, you will have stability problems. The transistor can be just about any general purpose NPN you have around. The output should be connected to your mike input, and the control adjusted to give about 5–10 kHz deviation.

Decoder

The decoder is a twin-tee circuit followed by a dc amplifier. The input level control can be brought down to give you a bandwidth as narrow as ±30 Hz! The two input diodes clip the incoming signal to a maximum value of 0.2V peak to peak; they can be any general-purpose germaniums.

The output of the decoder is rectified and fed to a standard dc amplifier; the relay in the collector of Q_2 is the one I had in my junkbox, so you might have to experiment with the value of R_5: the relay should close at about 6V and 6–10 mA.

The input should be connected to the discriminator output of the receiver. The input pot should be set up so that the relay closes reliably every time the encoder is keyed; it helps to have a friend stay home to adjust it while you drive around. A 30–50 μF capacitor can be connected after the diode to give a turn-on time delay of 3 to 5 seconds; this will not be applicable to standard repeaters, but it could prove quite beneficial for remote control for those of you who have friends with strange senses of humor. With the capacitor in the circuit, an audio generator sweeping your frequency will not trip the decoder.

A heavy duty relay must be connected at the output, since the contacts on a sensitive relay are rated at only a couple of watts; a ratchet relay can also be used for latching on–off operation.

One final note: If you are going to use the system through an open repeater, be discreet. It is very annoying for people monitoring the frequency to hear tone bursts coming through; and finally, be sure to ID each time you use the unit.

...VE2BZK

ON.. EFFICIENCY ORGANIZATION and MAGAZINES

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Contrary to popular belief, the most efficient method of organization is no organization whatsoever. In the case of a personal magazine collection, if you could *remember* the precise location of every article you have accumulated, you would never waste time hunting for a particular schematic, or putting the copy back in its "proper place." Since most of us do not have perfect memories, some organization is necessary to find the information we need in the mess we accumulate. The important thing to remember is: the more organized (and complicated) a system is, the less efficient it will be.

Indexes are remarkably inefficient devices for using information. A typical index assigns each article an individual position *and* locating file card. To use the index as efficiently as possible, one must keep both the magazines and the file cards in order. Additionally, when one is interested in information on a single topic, there is generally a separate magazine to find for each article, and a page to mark so one can refer back to it. Many of these articles will be useless and the magazines must all be replaced in order when the project is complete, or if the library is to be used again.

The method I use requires a minimum of organization as well as the wholesale destruction of the magazines in order to separate the individual articles. For those of us who enjoy collecting the complete set of magazines, this thought is like being against apple pie, motherhood, and The American Way. Nevertheless, *information you cannot find is useless*, so if you want to keep your magazines intact, I suggest you start in on your first thousand file cards, while the rest read on.

All pages of each important article must be removed from the magazine and stapled together. Each article should be marked on the top of the first page with filing subject (and magazine and date, if not printed in the article itself). All articles of the same subject are placed in a manila file folder which is filed alphabetically according to subject. The topics should be carefully chosen for their ideas, or underlying principles rather than their English names. For example, in one file labeled "mixers" I

keep articles on rf mixers, rf converters, AM modulators and demodulators, and other related devices. Af mixers are filed in my "hi-fi stereo" folder, and other systems of modulation are also filed separately. Those articles which are redundant or not worth keeping are discarded with the advertising, but make *sure* to keep everything you could ever possibly want. The volume of the information will be reduced at least by half, and probably more.

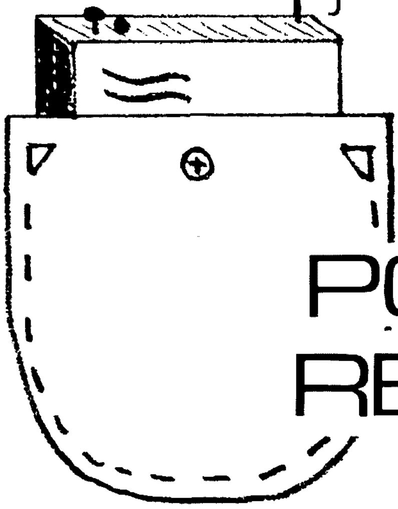
Occasionally an article is important in more than one area, so a note must be placed in one file that the article exists in another file, or (wonder of wonders) a duplicate made. Often, articles destined for different files contain a common page. These could be handled in several ways, but I hate to separate the pages of any article, so I bind these articles together, marking the topics of interior article(s) on the first page. Then the whole thing is filed under the subject of the most important article, using notes again where necessary. It is important that the system be kept manageable; when a folder fills up, it is time to discard some useless articles in the folder, or start a new subdivision of information.

This system pays for itself in the blinding speed with which one can find the details of a particular idea or design (even if you have forgotten where and when you read it), but there is more. All articles in similar fields are filed together, which is a tremendous advantage; if you want to build a converter, all important articles on converters are in one place. In one folder might be schematics of the most recent UHF converters, old VLF converters, as well as articles on conversion theory and design.

The disadvantage of the system lies in not being able to identify a specific magazine *per se*. This would be a major disadvantage to a library with many published indexes at their disposal, but for the individual who wants to *use* the information, the disadvantage is mostly imaginary. If the article is important, it will be in the proper file.

... WA3BKC ■

220 MHz converter for FM POCKET RECEIVERS



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Peterborough NH 03458

This article describes a low cost, two-transistor converter for use on the 220 MHz band, using any of the "police band" FM receivers that cover 146 to 180 MHz.

The availability of these pocket receivers, made by the Nagasaki Hardware Co., in the Not-So-Far-East-Now, was highlighted by K9STH in 73 Magazine, July 1970, page 44. A recent proposal to open up 220 MHz for no-code hobbyists prompted the building of a foundation converter as an almost instant means of seeing what could be done today with low-cost solid-state 220 MHz rigs. The Allied-Radio Shack Model A-2587 was used as the i-f, discriminator, and af, on about 170 MHz. This is the output frequency of the converter being described when using a 50 MHz crystal in the oscillator.

The A-2587 receiver uses a miniature *telephone* jack for the 50Ω antenna connection, but as long as it works, who is to say no? The insertion of this "antenna plug" into the antenna jack on the receiver also cuts off the extendable antenna very nicely.

After removing the telephone plug from one of those little plastic-wrapped white earphones that always accompany a Jap receiver, I converted it to an "RCA phono" adapter, making up the 170 MHz connection between the converter and the receiver.

Figure 1 shows the converter circuit using a Motorola HEP 56 transistor, good for 750 MHz use, as the mixer, and a HEP 55 for the 50 MHz oscillator.

No attempt to achieve low-loss high efficiency was made, because the later

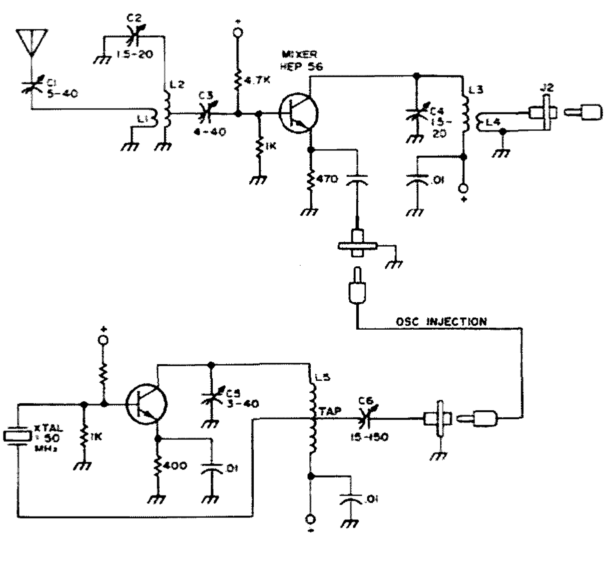

Fig. 1. Schematic, 220 to 170 MHz FM converter.

installation of one or more low-noise figure rf stages is assumed.

At any VHF shack with a crystal within the 48 to 54 MHz range on hand, this unit can be assembled, wired, and tested easily in a day. The only thing to watch for, as always with an i-f near the signal frequency, is oscillator harmonics getting into the front end. The third harmonic at 150 MHz is pretty loud when you do tune across it (which you do *not* need to do, by the way). This harmonic can be dropped 20 to 30 dB by use of a series 50 MHz filter in the oscillator injection line, but was not found necessary here.

A small minibox will contain all the parts for this converter if you want to make a permanent unit out of it. It can also be made to fit flat on the back of the A-2587 receiver case if you want.

Generous use was made of Arco trimmers, and hand-wound coils did the rest, with nothing critical showing up, except that emitter oscillator injection was a *must*. Base injection at 50 MHz into a 220 MHz mixer did not work well at all.

A signal generator, 170 MHz tuned circuit (see Fig. 2), diode detector, and voltmeter were used to tune up the circuits and adjust the couplings. If you try and use the receiver as the i-f while doing this, you may succeed, but I find that the sensitivity tends to mask the desired results. Suit yourself on that. When you get a good solid dc signal out of the diode tuned to 170 MHz your converter and i-f output circuit are really working.

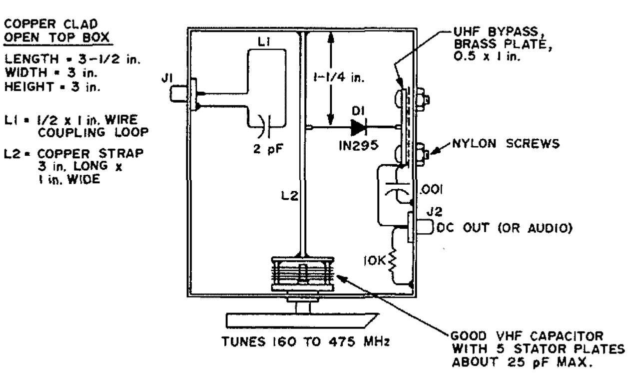

Fig. 2.

For new readers the 170 MHz diode detector is shown in Fig. 2. It also tunes up to 450 MHz, and will go down to 144 as well with slightly smaller dimensions and a 35 or 50 pF capacitor, thus covering three amateur bands.

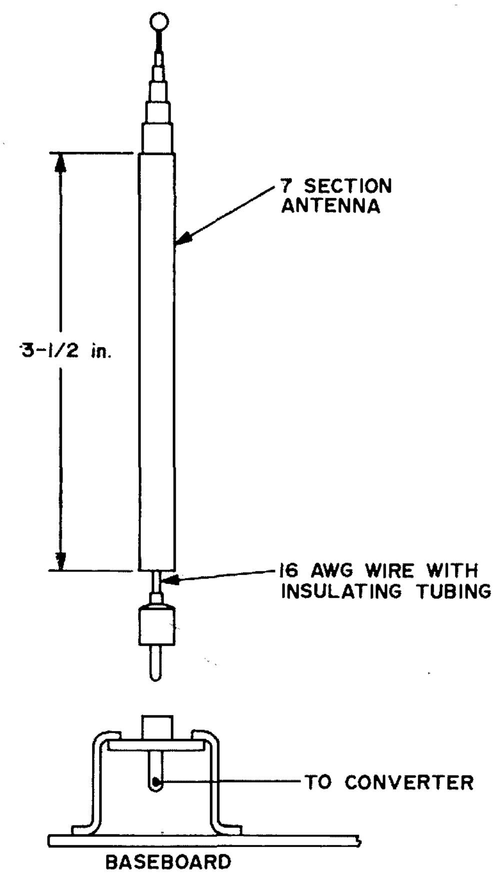

Fig. 3. 220 MHz breadboard antenna.

Coils for all schematics are listed in the following chart:

Coil	Wire No.	No. of turns	Length of coil	Diam. of coil	Position
L1	22 insul	2	¼"	3/8"	End of L2
L2	18 bare	3½	½"	3/8"	
L3	18 bare	4	¾"	3/8"	
L4	22 insul	2	¼"	3/8"	End of L3
L5	24	15	3/8"	on 6/32 paper tube	Tap in center

. . . K1CLL ■

MAGNETIC DEFLECTION for SSTV

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Because of the lack of inexpensive electrostatic deflection CRTs on the surplus market and the impracticability of electrostatic deflection on CRTs larger than 5 in., I managed to apply magnetic deflection to my SSTV station. Magnetic deflection tubes such as the 5FP7 and 7BP7[1] are currently inexpensive and available in large quantities on the surplus market; therefore, they extend themselves to use by amateurs on SSTV with limited resources.

The heart of my magnetic deflection system is the deflection yoke, which needs some explanation. The yoke is a radar type which was to be used in an electronic (rather than mechanical) rotary sweep system[2]. The square yoke is a more common older version, and the round yoke is a newer version manufactured by Atlas Coil Co. for RCA. However, both types are electrically identical. The coils have between 60 and 300 ohms dc resistance, and they have a common red wire to which B+ is connected (Fig. 1).

These coils, though seldom advertised, are rather inexpensively acquired from surplus dealers because of their supposed uselessness. My neighborhood surplus dealer had 15 of these yokes selling for $2 apiece. If you're unable to obtain these coils locally, try writing some of the mail order dealers about them; chances are they'll have some. If this fails, I am able to supply a limited quantity at $2 apiece plus postage. You might also be able to obtain an assembly which contains them, such as the BC-1092. One word of caution: Make sure the coils are for the electronic system. The best way to be sure of this, if they're in a radar unit, is to check around the neck of the tube for a selsyn; if there isn't one, you're probably in luck.

Standard 55-degree deflection coils for TV are too inefficient at the scanning frequency to be used with anything less than 200 mA of current. However, they may lend themselves nicely for transistor work.

The deflection amplifier tubes aren't critical. Any tube capable of handling the required current can be used. To determine the required deflection current you can put a low voltage dc supply and a meter on the coils, as shown in Fig. 2. Bring up the voltage (6–12V) until the beam is fully deflected from the center to one side and that current is your required deflection current. The B+ common on the coil can be found by a resistance check since all four coils have identical resistance.

In MacDonald's SSTV monitor[3] it was necessary to change R10 from 50 MΩ to 30 MΩ to get adequate vertical deflection on a 7 in. tube. The .006 μF coupling capacitor from pin 1 of the vertical trigger to pin 1 of the vertical discharge tube should be increased to .05 μF to discharge

C3 due to the higher charging voltage. Transformers T3 and T4 in the video circuit can be changed to a plate-to-push-pull-grids (1:2 ratio) interstaged transformer since breakdown voltage no longer is a critical factor.

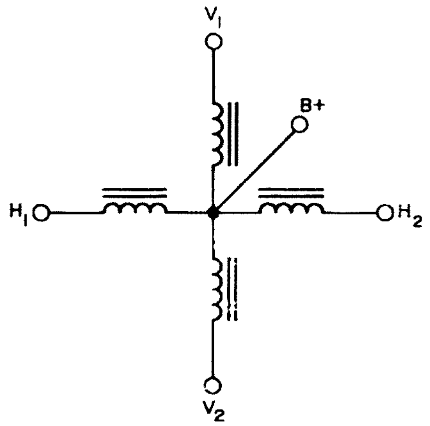


Fig. 1. Radar deflection yoke.

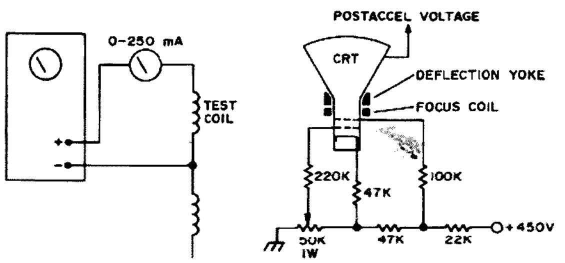


Fig. 2. Coils must be mounted on CRT and the CRT must have the same postaccelerator voltage as your monitor will supply.

The input to the deflection circuit should be at the junction of the 27 kΩ resistors in the cathode circuit of V7.

The 200Ω wirewound balance control should be set so that nearly equal currents are drawn by each tube. This can be determined easiest by temporarily adjusting the bias controls for maximum resistance, grounding the grids, and removing screen voltage. Then adjust the control to approximately equal voltage on the cathode.

The 500 kΩ bias controls should be set by feeding a 15 Hz signal into the amplifiers and putting a scope on the cathodes of the output tubes. (On the 15 Hz amplifier one end of the cathode bypass has to be removed temporarily.) Adjust the bias control for the best sawtooth wave forms on the scope. Since the vertical signal is practically dc (.075 Hz), the 15 Hz signal will have to be temporarily used in making the bias adjustments for the vertical deflection amplifier. Slight balancing can be made with the bias controls, if required, as long as the waveform doesn't change too much.

If a 5 in. tube is used it may be necessary to increase the screen resistor to lower the sweep of the unit, or a 100 kΩ 2W pot could be wired in if a gain control is desired. If a larger CRT is used it will be necessary to increase plate voltage and perhaps change tubes, depending on how much deflection is needed. Keep in mind that if a larger CRT is used it must have approximately a 55-degree deflection angle.

The high voltage required for the electrostatic CRTs can be eliminated, although a 4 to 8 kV (depending on CRT) postaccelerator rf supply will have to be built. An alternate circuit for the −120V line in the monitor is shown. The rf supply is fairly straightforward; CI and LI are resonant at approximately 15.750 kHz. Almost any horizontal output tube can be used for V3. For a 5FP7 only 4 kV is needed so the booster diode can be eliminated. If greater than 8 kV is needed for the CRT it may be necessary to put some inductance in (where the TV set's deflection coils were connected) to make up for not connecting the TV set's deflection coils, or if this doesn't help, a voltage doubler can be used. Just add another 2-turn link for the filament of the other rectifier.

The new voltage divider string for most magnetic deflection tubes is shown in Fig. 3 and needs no explanation. The .01 μF capacitor is connected to the grid of VI to supply vertical retrace blanking, and can be moved to the plate of V2 if more blanking is required. If this capacitor is connected to the grid of VI, a 600V unit will do well; otherwise, a 3 kV unit will be needed because of the inductive kick of the deflection coil when the vertical sync pulse comes.

For focusing of the CRT a permanent magnet unit with a centering control would

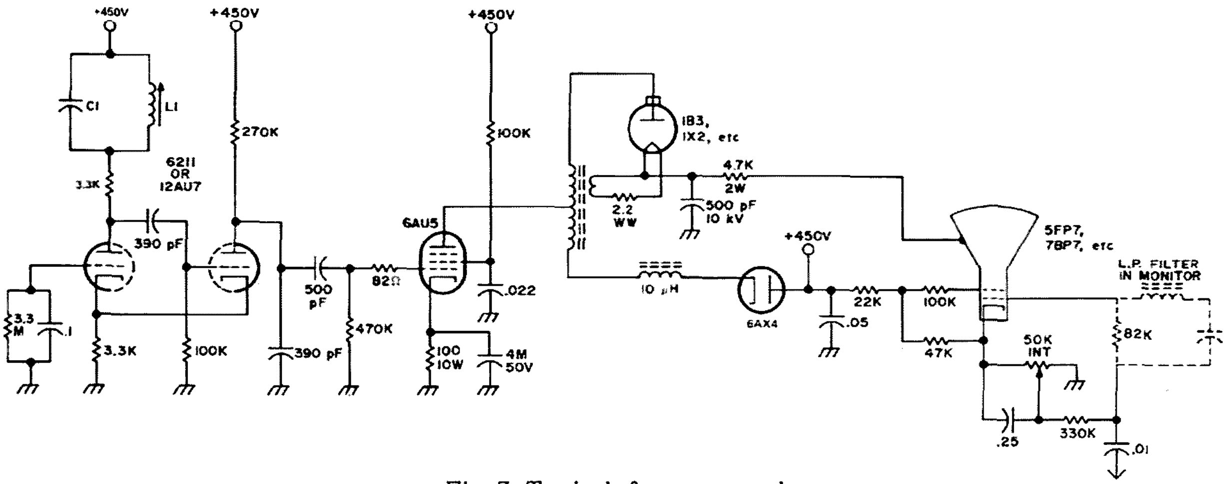


Fig. 3. Typical rf power supply.

be best. If an electronic focus is desired, the circuit in Fig. 4 can be used for most focus coils. Do not be tempted to connect this to the 250V line since this is arrived at by a dropping resistor, and the changing current of the focus coil with adjustment will vary the 250V line.

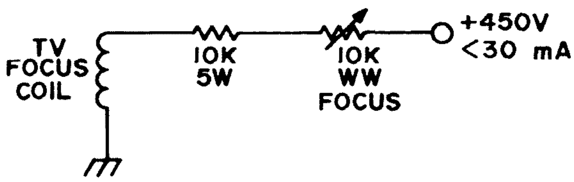


Fig. 4. Electronic focusing circuit.

As for the B+ power supply, remember it will have to supply an additional 160 mA for the deflection amplifiers so make sure the transformer can handle it. Also make sure the supply is filtered well enough so ripple doesn't appear.

If this type of deflection is wanted for a flying-spot scanner such as K7YZZ's[4] it could be done by using the circuit in Fig. 5. I suggest that this cathode follower be used even if you are using an electrostatic tube. I encountered too great a voltage imbalance on my electrostatic deflection amplifiers to get them to operate linearly.

I would also suggest the use of a blue filter on the face of the CRT, if a P7 phosphor is used, such as "surprise pink"

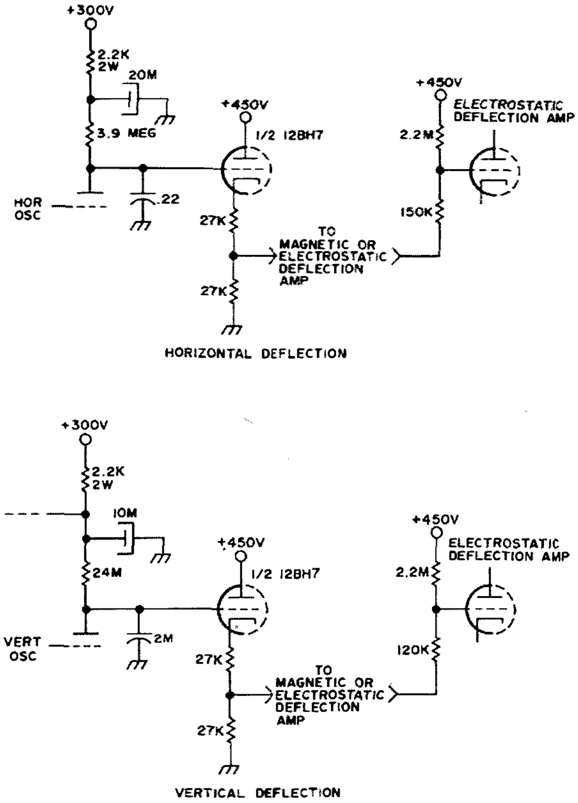


Fig. 5. Modifications for using magnetic or electrostatic deflection on K7YZZ's flying-spot scanner.

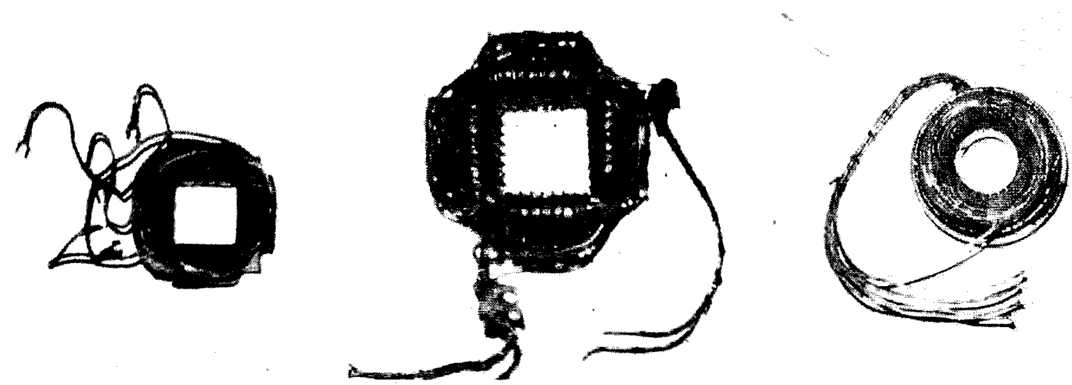
(the surprise is that it's blue) or "steel blue." These gels can be bought for 40¢ from a theatrical supply house.

Also, mount the photomultiplier tubes at least 4 or 5 in. away from the card and slightly on an angle as shown in Fig. 6. This is to reduce shading. If the PMT is going to look directly at the CRT, mount it at least 8 in. away to reduce parallax. In any case,

make sure the boxes containing the CRT and PMT are light-tight. Paint the insides flat black and use felt or foam rubber to fill in any gaps in the wood joints.

Remember that in the monitor driven sweep is employed. Therefore, it will be necessary to be receiving an SSTV picture for a raster to be displayed. If a test tape is needed you can send me or most other hams on SSTV a 3 in. blank tape with the speed you wish it recorded at (3 and 3/4 ips usually) and I will record you some pictures. (Also, if you require a tape of the three audio tones I can record that for you, but please include return postage.) I would also like to hear from other hams building SSTV or fast-scan TV equipment. If any difficulties in constructing this equipment are encountered feel free to write me.

I hope this article will help you get on SSTV with as little difficulty as possible. I would like to thank Doug (WB2UDF) and Bob Beach (WB2WRX) for their support on the project.



These deflection yokes are essentially identical even though their configurations differ. The square yoke is the older type. The round one, relatively modern, is manufactured for RCA.

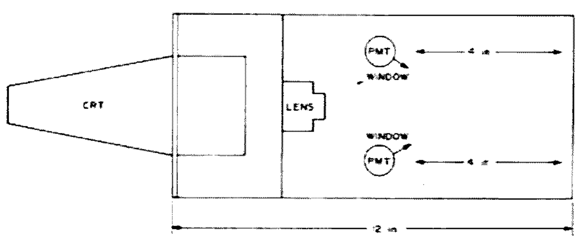


Fig.6. Photomultiplier positioning and optical system layout.

References:

[1] Sources for CRTs:
Arcturus Electronic Corp.
Fair Radio Sales Co.
United Radio Co.

[2] *Radar System Fundamentals*, TM11-467.

[3] *A Compact Slow-Scan TV Monitor*, MacDonald, QST, March 1964.

[4] *A Slow-Scan Television Picture Generator*, Hutton, 73, October 1967.

. . . WB2ZIV ■

by Ken W. Sessions, Jr.
K6MVH

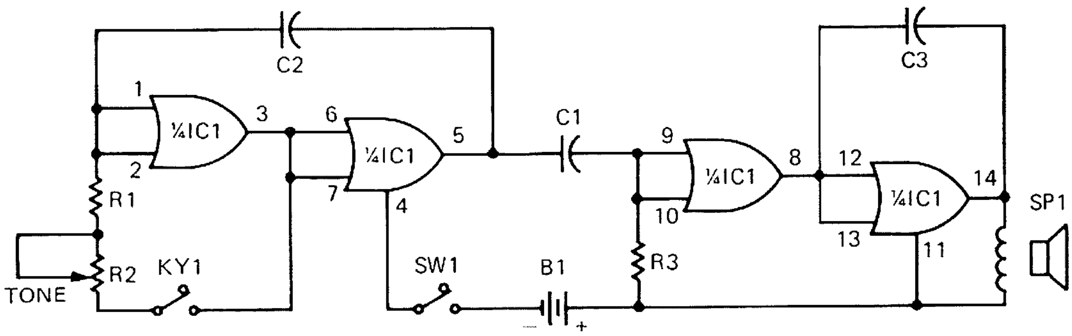
BUILD AN 8 TRANSISTOR CODE OSCILLATOR WITH JUST 1 IC

A code practice oscillator is practically always a simple affair. But with a good IC, such as Motorola's HEP 570, the project can be made even simpler while the circuitry itself – within the integrated circuit – stays complex enough to assure plenty of audio gain, good stability, and excellent quality of tone.

The oscillator described here was designed by experts at Motorola, who allowed for four "discrete" stages, each with a two-transistor capability, within the framework of the lone flatpack IC package. One of the nicest features of the HEP 570 as the oscillator element is its economy of external parts. Apart from the power switch, the telegraph key, the speaker, and the battery, the only additional components required are two resistors, a pot, and three capacitors. What could be simpler?

Construction is as simple as the schematic (Fig. 1) makes it seem. One item not shown on the schematic, however, could make the job easier and save the insecure builder a great deal of grief: a suitable socket for the IC. An advantage of using IC sockets is that if all does not go well right off, the IC remains isolated from the rest of the circuit while changes are incorporated. Also, most hams use their ICs again and again, for any number of appropriate projects. Soldering of an IC directly into a circuit will seriously curtail its universal utility. The package can't stand too many solder/unsolder operations before the leads give out. But with a socket, the IC stays like new and may be used in as many projects as the builder has sockets for. And changing the IC from one project to another is no more difficult than making a tube change in an old-fashioned rig.

Your junkbox will undoubtedly yield the resistors and capacitors necessary to complete the oscillator project, but it is unlikely that you'll find the right speaker kicking around the shack. Since the output of the amplifier/oscillator is in the vicinity of 50Ω, a standard "intercom-type" speaker is required. If the expense of such a speaker proves a bit much, there are



PARTS LIST:

IC1	HEP 570	R3	10 K	SW1	SPST	SP1	45 Ω
R1	3.9 K	C1, 2	.05 μF	KY1	MORSE KEY		INTERCOM
R2	10 K POT	C3	.001 μF	B1	3 VDC		4" SPEAKER

Fig. 1. Schematic of the "8-transistor" code practice oscillator made with a Motorla HEP 570 IC.

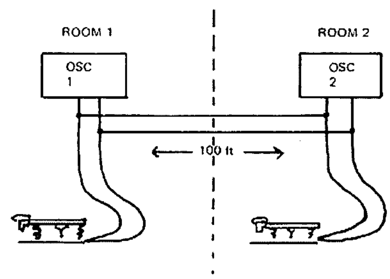


Fig. 2. If the distance between operating stations is held down to a reasonable value a CW intercom setup can be made with two or more code oscillators. If you've got kids in the family who can't find time to practice their code for the Novice exam, this arrangement is sure to turn the trick.

other routes that might prove entirely satisfactory, such as scrounging up matching transformers that can be used to drive either a speaker or an external amplifier arrangement.

One method that has proved adequate is to use an ordinary low-voltage power transformer to couple from the IC to the speaker. A transformer with a primary winding of 120V and a secondary of 12V provides a reasonable approximation of the proper turns ratio, and will deliver a fairly healthy audio signal to a 3.2Ω voice coil. Since power-handling capability is no consideration, you can use the smallest physical size of transformer you can get your hands on. The only disadvantage with this approach is that it plays hob with any attempt toward miniaturization.

A small chunk of perforated board makes an ideal mounting bed. If the small intercom speaker is in your list of "availables," you can easily mount the whole affair in an enclosure no larger than a tiny portable radio. If you have to use the power transformer, you'll have to just poke around for a chassis with enough bulk to accommodate everything.

An obvious "extra" that will enhance the usefulness and attractiveness of your oscillator are matching jack and plug for the sending key. This will also simplify the use of another code oscillator for two-way operation.

To couple a pair of code oscillators for two-way use, it is better to parallel the keys rather than the speakers themselves. This approach keeps each unit from the labor of driving more than its fair share of the load. Figure 2 illustrates an excellent room-to-room interconnect method that has already been used to bring two new Novices to the bands. (Learning the code is fun if there is some incentive to study; and a room-to-room CW intercom will work wonders with harmonics who might otherwise be reluctant to practice.)

K6MVH

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THE BEEPer

Meet the Beeper! A small transmitter, a light flasher circuit and a multivibrator combined into one integral unit. The Beeper's unique circuitry utilizes eight transistors to send out a tone-modulated six meter signal to any nearby receiver. Interested in how the Beeper can be used?

The Beeper is ideal for hidden transmitter hunts, since its off-on transmitting cycle adds to the difficulty of getting a fix on the

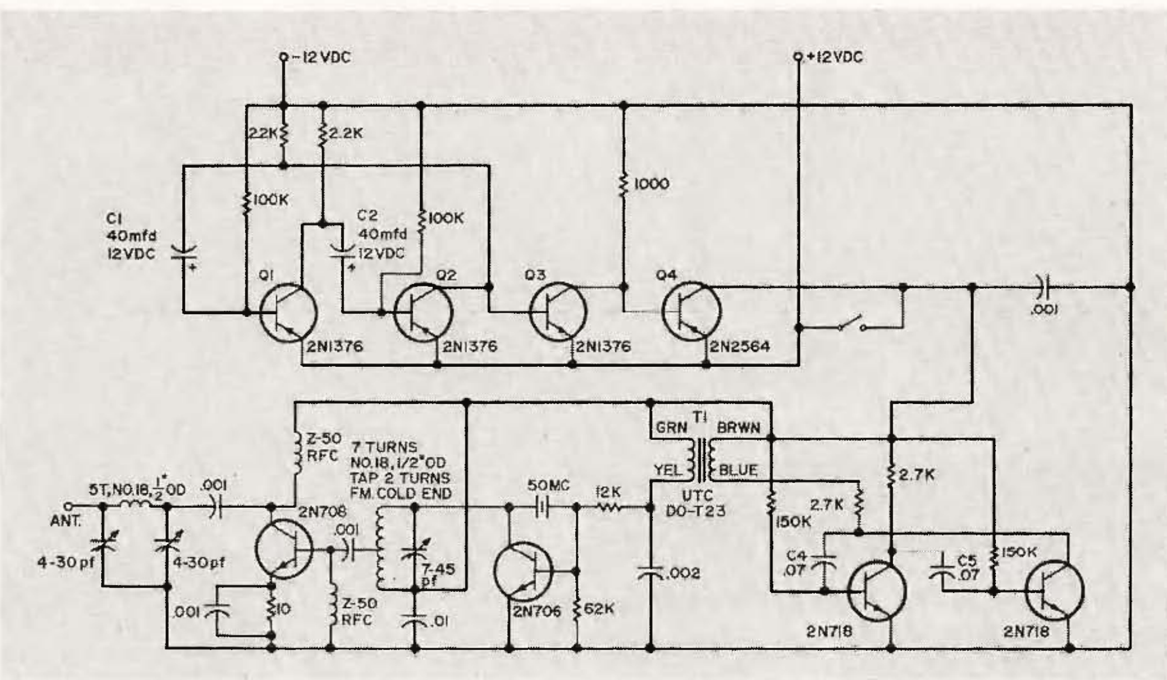

Fig. 1. Schematic for the Beeper. All resistors are ½ watt.

hidden unit. Amateur rocketeers should find this circuit ideal for use in larger-sized rockets. A miniaturized Beeper located in the nose-cone of a downed, lost rocket would aid greatly in finding it.

The Beeper emits a tone-modulated six meter carrier which cycles off and on. The heart of the unit is the transmitter which consists of a 2N706 overtone oscillator followed by a 2N708 amplifier. The transistors used in the transmitter are not critical. Literally any NPN rf transistor can be used with good results. I tried an epoxy transistor from a scrapped uhf tuner in the final. The output increased 25%. The output is normally 100 milliwatts or better.

Even though the duty cycle on the transistors is light in the Beeper due to the rf cycling, the transistors do get quite warm if the flasher circuit is jumped out of the circuit. In any case, a simple heatsink can be made for the amplifier with a pair of tin snips and some aluminum stripping. The crystal oscillator uses a 50.385 MHz overtone crystal. I was able to get several from a surplus crystal outlet for $1.60 each. The crystal I used doesn't use a socket, but is wired into the circuit. Leave at least 1/2 inch of wire on each lead and use heat sinks when soldering. Excessive heat will ruin these crystals and an ounce of care may save you $1.60 plus postage. Sockets were used for the transistors in my unit since I wanted to try the several kinds I had on hand to find which would give the best results.

The modulator is a multivibrator coupled into the base of the 2N706 oscillator. The modulation was judged to be in the neighborhood of 75%. Unfortunately, I was unable to get enough rf to give a readable pattern on a scope. However, if the signal is strong enough to move the S-meter, it can be heard.

Both the multivibrator and the transmitter derive their operating voltage from the output of a light flasher circuit developed by RCA. The flasher circuit consists of transistors Q1, Q2, Q3, Q4, and their associated parts. Notice that while the flasher circuit uses PNP transistors, the transmitter and modulator use NPN's. Since the output of the flasher is negative, the flasher must break the negative ground return of the modulator and transmitter. The rate of the flasher can be changed by adjusting the values of CI and C2 until the desired rate is found. An increase in capacitance will increase the time interval between beeps. The length of the beep itself may be changed by changing the value of C2. If you desire to vary the tone of the beep, changing the values of C4 and C5 will do the trick. A word of caution–multivibrators are inherently rich in harmonics and, if you are not careful, you can get a pretty wide carrier out of the Beeper. With the values shown, the Beeper will be modulated by a tone of about .5 kHz with a bandwidth of less than 25 kHz. Transformer T1 tends to limit the high frequency response eliminating serious spurious sidebands.

The prototype was constructed on a springboard to aid in designing and part substitution. The finished unit was built on a small piece of Vectorboard. Care should be taken to provide a good ground for the transmitter stages. They are slightly regenerative and poor grounding may set up a feedback loop. The best way to build the unit would be for the more industrious ham to make his own circuit board. Since most of us are weekend experimenters this approach may not be too practical.

To facilitate tuning up the transmitter, the flasher circuit should be bypassed. Connect a number 47 pilot light to the rf output jack; this will serve as a dummy load and rf indicator. For the initial tuning, no more than 9V should be used. First tune the oscillator (C10) for maximum as indicated on a nearby receiver, grid dipper (in the wavemeter mode), or a sensitive field strength meter. As you increase the capacitance, the output will become greater and then suddenly quit. Check this on a receiver, as the oscillator may break into spurious oscillation. When the point is found where the output is greatest, turn the capacitor back 1/8 turn; this will insure that the oscillator will start after the voltage is removed and turned on again.

After the oscillator is tuned, proceed to adjust C8 and C9 for maximum output as indicated on the 47 bulb. The final tuning may interact with the oscillator so you may have to adjust both until you get the desired

results. The transmitter adjustments may affect the quality of the modulation, so listen to the signal on a receiver to make sure everything is to your satisfaction. Now connect the flasher circuit. The Beeper should start to beep off and on. If it doesn't, check the flasher output with a voltmeter; if it is okay, chances are that the oscillator is not breaking into oscillation. Readjust C10 if this is the case.

When the Beeper is connected to a 12V volt power source, there should be enough rf present to light the 47 pilot lamp to half brilliance. My Beeper will operate with less than a volt. Don't be tempted to increase the voltage to gain more output. The unit draws 20 mA when it is not transmitting and about 150 mA while transmitting.

Never operate the Beeper without some form of load, and try to provide as good a match as possible. The modulation quality seems to be directly related to the quality of the antenna used, and a good antenna is also cheap transistor insurance. Generally, the transmitter will not have to be retuned after the initial settings are made, and the final tuning is quite broad. A quarter wavelength of wire will radiate a signal over several miles of open terrain. I was able to receive the signal two miles away from the Beeper with a Lafayette HA-650 portable transceiver using the whip antenna supplied with the HA-650. With the same setup and using the S-meter on the HA-650, I was able to locate the Beeper within a few feet of where it was hidden by a friend.

The Beeper can be put together in a few evenings. Most of the parts used are not critical, and it should be easy to find substitutes for most of them. The UTC transformer which I specified for use in the modulator may be difficult to find. If one is not available, almost any high impedance interstage transformer will work satisfactorily. If you desire, the flasher circuit and/or the modulator can be eliminated from the Beeper.

The Beeper does its job well, and it can provide its owner with many hours of fun. Why not build one and then get the local six meter group together for an old fashioned transmitter hunt? Happy Beeping!

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STUDY GUIDE GENERAL CLASS LICENSE

Part VI Gazintas and Gazoutas

By now it should be obvious that in this wacky world of electronics and ham radio, everything depends upon everything else – which makes it most difficult to name a single component as "the cornerstone" on which the whole setup rests.

But were it necessary to do so, the amplifier would be a prominent candidate for the position. Without amplifiers, neither radio nor any other application of electronics as we know them today could exist. Amplifiers are an essential ingredient of every oscillator, of every transmitter, and of every receiver, and in their absence we could expect little more performance than Marconi achieved seven decades back.

Because amplifiers are so essential, a number of questions on the General class examination are intended to test the applicant's knowledge of them, and many others which do not deal on the surface with amplifiers as such nevertheless require a knowledge of amplifier principles to answer.

In this chapter, we're going to discuss amplifiers, and cover the study list questions which deal directly with this subject.

Questions dealt with are:

20. What are some possible causes of excessive plate current in a class C power amplifier?

45. List the three main classes of amplifier operation and explain the use for which each class is best suited.

47. What is meant by "flat-topping" of a single sideband signal and what are some possible causes of it?

48. What does grid current flow in a class A amplifier indicate?

As usual, rather than dealing with these questions specifically, we'll rephrase them into more general ones.

For a start, let's ask "What is an amplifier?" This basic knowledge will be necessary in order to classify amplifiers into the three main classes.

We can continue by asking "How are amplifiers classified?" This is not just a rewording of question 45, because a number of classification techniques exist, one of which has only two main classes (and which makes more sense in general than the conventional approach, though it's not the answer the FCC expects).

Once we know what we're talking about and how they are classified, we can wind up the discussion on a more practical note with "How and why do amplifiers misbehave?" In getting answers to this, we'll cover most of the more common types of problems encountered,– but we hasten to point out that it's impossible to cover all the problems, because many are highly improbable and so occur at such extended intervals that no one person could hope to list "all" the possible troubles with amplifiers. Fortunately, a solid knowledge of basic principles goes a long way toward helping cure these "rare diseases" of the circuits.

What Is An Amplifier?

Several acres of paper could be (and probably have been) covered with words in unsuccessful attempts to provide detailed answers to the question "What is an amplifier?" It gets complicated because an amplifier need not contain either tubes or transistors (although most of those you're likely to meet in amateur radio and particularly in the FCC exams do), and for that matter need not even be an electronic device!

For instance, one of the simplest imaginable amplifiers of mechanical force is a lever, or pry-bar. Our amplifiers are, in some ways, merely the electronic equivalent of levers.

In electronics, though, the range is a bit more limited, and we can define an amplifier in general as a circuit which increases the power level of an electrical signal. Most such amplifiers have at least two "ports" or sets of terminals, one for "input" and the other for "output" – and thence comes the possibly puzzling title of this installment, because some technicians with a high disregard for engineeringese like to refer to these ports as the "goes into" and "goes out of," slurring the words to "gazinta" and "gazouta."

As we've defined it here, then, an amplifier is a device with an input and an output port (Fig. 1), and any signal fed into the input will appear at higher power level at the output. This definition isn't really tight enough to get through engineering courses with, but it's good enough for everyday use.

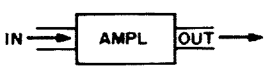

Fig. 1. Any amplifier can be considered to be a black box with two ports, one for input and the other for output. Amplitude of signal applied to input is changed by amplifier as signal passes through to output.

It leads, naturally enough, to another question, though. If an amplifier boosts the power of a signal, then what, pray tell, is a "signal"? As we use the term throughout this study course, a signal is a sequence of electrical power levels which, by their variation, carry some sort of information. This information may be the mere fact that the signal is present (as in a power signal), or it may be as complex as a composite video/audio TV broadcast signal.

The reason we define signals as "sequences of power levels" rather than in terms of "voltage" or "current" variations is that voltage and current have little significance of their own when we speak of signals – only the combination of voltage and current (or power) is meaningful. For instance, a simple transformer can double the voltage present in a circuit, but it doesn't change the power level much, and the change it does introduce is loss rather than gain. Therefore a transformer is *not* an amplifier.

The only types of amplifiers we'll be

going into much detail about here are those which employ vacuum tubes or transistors as their "active devices" or amplifying elements, although other kinds are possible. Some of these other kinds include magnetic amplifiers, which change the coupling in special kinds of transformers, and diode amplifiers, which make use of special properties of certain special kinds of diodes. The common types, though, use tubes or transistors, and since those are the ones covered on the FCC exams, they're the ones we'll concentrate upon in this course.

In these amplifiers, the "power" characteristic of a signal which we mentioned a few lines back is of critical importance, since almost all common amplifier circuits make use of their active devices as variable resistances which "valve" steady new power from a power supply into the output circuit, under control of the input signal. We've already examined this action in vacuum tubes and in transistors. The only new point we're making now is that this variable-resistance property of the device is the normal situation in most practical amplifier circuits you're likely to run across.

As we saw much earlier, the relationship between voltage and current at any one point in a circuit may be described in terms of resistance or, more generally, impedance. Since most practical amplifiers operate with ac signals, "impedance" is the way it's specified. The characteristics of an amplifier's ports are usually described in terms of their impedance level, and either the voltage, current, or power to be applied there. With impedance specified, voltage, current, and power are virtually interchangeable units, since the current or the power may be calculated if voltage and impedance are known, and similarly voltage may be calculated if current or power and impedance are known.

This specification is usually given in terms of the maximum signal level, and it's not at all uncommon to find an amplifier's input rated in voltage/impedance while the output is rated in watts. Many hi–fi rigs, for instance, are rated for a maximum 50W out at 16Ω, and maximum 0.5V in at 500 kΩ. These port ratings are important, but they do not normally tell us much about the amplifier's performance. Performance of an amplifier is usually described in terms of gain and distortion, but this may vary depending upon the use to which the amplifier is to be put.

The gain may be given either in decibels, or as a ratio, so that it becomes difficult to compare amplifier ratings. A typical rf linear amplifier might be rated for 10 dB gain, input and output impedances of 52Ω, and require 100W input for maximum output. Such an amplifier would produce 1 kW output (10 dB gain with input of 100W). A hi–fi rig, on the other hand, might completely neglect to mention gain and merely give output and input levels together with distortion percentages.

Regardless of ratings, any normal amplifier operates by regulating the flow of current in its output circuit. If the amplifier is intended for use as a voltage amplifier (one in which the power gain is used to step up the signal voltage rather than signal

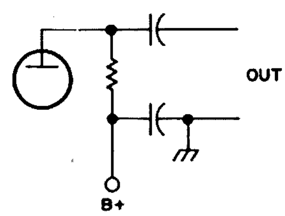

Fig. 2. Most common amplifier output coupling circuit at audio frequencies is resistance-coupled version shown here. Lower capacitor is not obvious on most schematics since it is called a bypass capacitor, but it serves the purpose of taking output as voltage drop across load resistor.

current), the resulting variations in output current flow are converted back into voltage variations by means of a coupling device which may be a transformer, a resistance, or an impedance. Most of today's amplifiers use resistance coupling (Fig. 2); as the current through a resistor in series with the active device varies, so does the voltage drop across that resistor. This

varying voltage drop is coupled out through a capacitor (to isolate the dc component of the signal) to the output port.

With transformer coupling (Fig. 3) the active device's operating current is supplied through the primary of a transformer. As this current varies, the changes induce corresponding current in the transformer secondary, which is connected to the output port.

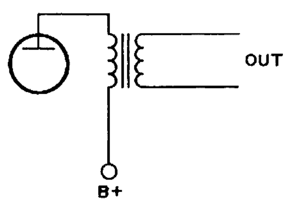

Fig. 3. Transformer-coupled circuit shown here is sometimes used in audio amplifiers, and often employed at rf where tuned tank circuits form the transformer. Transformer can produce highest efficiency of all coupling circuits, but is more costly than a resistor and two capacitors.

Resistance coupling is normally inherently high-impedance, although certain special circuits can bring the impedance level down to low levels. Transformer coupling, on the other hand, seldom produces extremely high impedance levels. It is used primarily to produce medium- to low-impedance ports, as for instance in the output circuit of a vacuum-tube hi-fi unit where the tubes' current must drive a 16Ω load. Rf amplifiers often use transformer coupling because an rf transformer can be composed of tuned circuits for selectivity; sometimes they use impedance coupling (Fig. 4) which is similar to resistance coupling except that an rf choke (inductor) replaces the resistor.

As you can see, amplifiers operate in many different ways, even though their basic principles are all similar. Because of

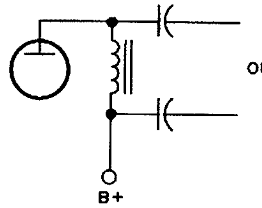

Fig. 4. Impedance-coupled circuit shown here is cross between transformer and resistance coupling. Ac output signal sees high impedance at choke, and capacitors couple out the resulting voltage drop. Tube's dc power, however, is not restricted.

this, it's been found necessary to classify amplifiers into various types for study and discussion. Many classification schemes are in use, and some of them are so widely accepted that they are part of the FCC examinations.

How Are Amplifiers Classified?

Just as we have many kinds of amplifiers, we have many kinds of amplifier classifications, because amplifiers are classified into groups, each of which has some character or property in common.

We finally restricted our definition of amplifier, for this chapter at least, to "a vacuum-tube or transistor device which boosts the power of its input signal" – and that in itself was a classification.

Within this classification, we could describe amplifiers according to their output coupling circuit. This would produce classifications such as "resistance-coupled," "transformer-coupled," and "impedance-coupled," which we were using only a few paragraphs back.

Another way would be on the basis of the frequency range handled by the amplifier: audio, video, rf, i-f, dc, etc.

We could divide them into voltage amplifiers, in which the power boost shows up as increased voltage with no decrease in current, and power amplifiers, in which the power boost is used directly.

All of these classifications are in wide use, but none of them attack the problems

of amplifier operating conditions directly. Thus, an rf power amplifier may be linear, or it may produce distortion, and these classifications will not help us determine why it acts as it does. To handle such needs, we must have a classification system which is based upon operating conditions – and one exists in an almost universally standard form.

The definitions published by engineering societies the world over, as cited in Terman's monumental text on *Electronic and Radio Engineering,* in the third and fourth editions of *Reference Data for Radio Engineers,* in Langford-Smith's *Radiotron Designer's Handbook,* and in Eastman's *Fundamentals of Vacuum Tubes,* are as follows:

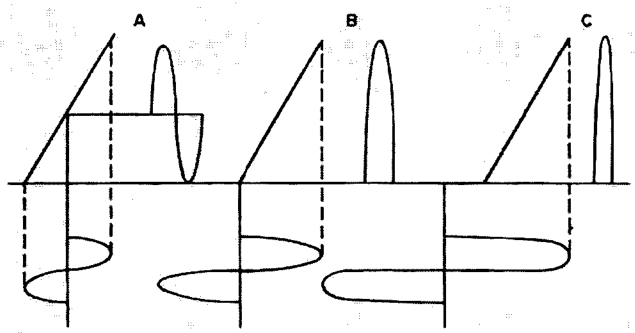

Fig. 5. Comparison of class A, class B, and class C operating characteristics is shown here for "ideal" amplifiers having perfectly linear characteristics across limited range. Diagonal line represents amplifier's action. Vertical lines indicate grid bias setting of amplifier; in class A, bias splits the operating range in half, while in class B only the positive-going half of the input signal is amplified, and in class C only a part of the positive-going half makes it through. No actual amplifier has such a straight characteristic, but this illustrates the differences in the classifications.

Unfortunately from our point of view, one authority defines these classes in a manner which is significantly different from the definitions agreed upon by most other authorities – and most hams have learned the classes from the one unique authority. This leads to an inordinate amount of confusion, disagreement, and downright unpleasantness at times. The best way to avoid this trap is to become familiar with both sets of definitions, and to know that two different sets exist; then you can pick your set according to the other fellow's rules, and discuss theory freely.

Incidentally, the key differences between the two sets of definitions do not appear in the FCC study-list questions, so they should pose no problems during the actual examination.

The classification system of which we speak divides all amplifiers into three broad classes, called "class A," "class B," and "class C" (Fig. 5), and goes on to define an overlap group called "class AB," which is a twilight zone between class A and class B.

"A class A amplifier is an amplifier in which the operating conditions are such that plate current in a specific tube flows at all times.

"A class B amplifier is an amplifier in which the grid bias is approximately equal to the cutoff value so that the plate current is approximately zero when no input signal is applied, and plate current in a specific tube flows for approximately one-half of each cycle when input signal is applied.

"A class C amplifier is an amplifier in which operating conditions are such that plate current in a specific tube flows for appreciably less than one-half of each cycle when input signal is applied and plate current is zero in the absence of input signal.

"A class AB amplifier is an amplifier in which operating conditions are such that plate current in a specific tube flows for appreciably more than half but less than the entire electrical cycle of the input signal."

We'll look at these definitions in much more detail shortly. First, however, let's

look at the conflicting set of definitions for classes A, AB, B, and C, as published in the widely circulated handbook for radio amateurs published by the ARRL (quotes are from the 1962 edition):

"A class A amplifier is one operated so that the wave shape of the output voltage is the same as that of the signal voltage applied to the grid . . .

"A class AB amplifier is a push-pull amplifier with higher bias than would be normal for pure class A operation, but less than the cutoff bias required for class B . . ."

(Class B operation is defined by means of a schematic diagram and four waveforms.)

"A radio-frequency power amplifier . . . can be used with an operating angle of less than 180 degrees. This is called class C operation."

It may appear that we're overemphasizing the differences in these sets of definitions, but in nearly 20 years of listening to on-the-air bull sessions get downright acrimonious simply because two people attempting to discuss amplifier operation didn't mean the same thing at all by "class A" or "class AB" or "class C," we feel that the existence of multiple definitions is an essential fact to know.

The major significance of the differences is that the engineers' version is based *entirely* upon an operating characteristic which can be precisely measured and specified; the flow of plate current in the amplifier throughout one cycle of an input signal determines that amplifier's operating class. If plate current always flows, it's class A. If current is cut off for part of the cycle, but less than half, it's AB. If cutoff is for approximately half a cycle, it's B. And if cutoff is appreciably more than half a cycle, it's class C.

The "amateur" definition, on the other hand, defines each different class by means of a different characteristic. It says that a class A amplifier is one which is free of distortion (that may not be what was intended, but it's precisely the meaning of the words used in the definition, and it's the way most people read them if you listen to the resulting arguments), while a

class AB amplifier must be push-pull, and class C applied to rf power circuits.

Obviously, we're somewhat biased in favor of the engineers' definitions. They appear to be much more precise, and should you happen to be interested in radio engineering from a career viewpoint, they'll do professionally as well as in your hobby. Now let's examine them more closely, and then see how the somewhat looser "amateur" definitions are related to those of the engineers – because in a most general and highly oversimplified way, the "amateur" definitions usually apply also.

The "class A" amplifier concept was originally intended to be that of an "ideal" amplifier which reproduced its input signal at the output, without distorting it in any way. In order to accomplish this, it would be necessary for gain to remain constant regardless of the signal level, and plate current could never cut off during the input-signal cycle (because if it did, that part of the cycle appearing at the input while current was cut off would fail to appear in the output, which would constitute distortion).

The engineers' definition of class A stems directly from one of the requirements of the "amateur definition" – but the reverse is not true. An amplifier can meet the engineers' definition even if plate current varies widely throughout the signal cycle, just so long as it never cuts off. With a wide variation of plate current, gain will also vary between wide limits, and the output signal will be distorted. In this case, the output signal will *not* have the exact same wave shape as the input, so the amateur definition is not fulfilled.

The class B amplifier represents an attempt to improve the efficiency of amplifier circuits, and dates from the days when radios all operated from batteries (before ac power supplies were available). A class A power amplifier cannot develop much output power in comparison with the power it takes from the power supply, since plate current must flow even when no signal is present in order to remain class A and this plate current is wasted so far as developing output is concerned. As a result, class A amplifiers normally produce a maximum of

about 1W out for every 4W drawn from the power supply.

By drawing power only half of the time and leaving the tube cut off for the other half of the input cycle, less power is wasted. On the other hand, with only half of the input signal appearing in the output, distortion of the amplified signal is extreme. Use of two tubes in a push-pull circuit reduces the distortion to acceptable limits, because while one tube is cut off the other is providing output and vice versa – and the push-pull connection is necessary in order to use class B operating conditions in audio amplifiers.

In an rf power amplifier, however, distortion of the individual cycles of rf does not matter because the tuned circuits have a "flywheel" effect which irons out the distortion. "Distortion" in rf power amplifiers usually means a distortion of the signal "envelope" or modulation, and this is not affected by the class B circuit. Therefore it's possible to use single-tube class B amplifiers in transmitters, and some "linear" amplifiers operate this way.

The ideal class B circuit is about twice as efficient as the same tubes would be if operated class A; that is, it provides up to 2W out for every 4W taken from the power supply. This means that batteries for such a circuit would last twice as long.

The class C operating conditions are just like class B, only more so. One textbook describes them, very accurately, as "switching" operation. The tube or transistor is operated with bias so far into cutoff that plate current cannot flow except at the very peak of the input signal cycle. Thus, this class of amplifier draws very little current most of the time. On signal peaks, the tube or transistor switches from "off" to "on" and permits a brief pulse of current to flow. Since it is essentially a switch, this current pulse can have extremely high values – a full ampere isn't uncommon. The high-energy pulse causes the tuned rf output circuit to "ring" at its resonant frequency, and with another pulse coming along at the peak of every cycle, most respectable power levels can be developed.

The class C amplifier can theoretically produce as much as 3.8W of output for every 4W taken from the power supply, but practical circuits seldom deliver more than 3 for every 4. This is still three times as efficient as the same tube would be in class A, and since amateur power limits are set on the basis of input power rather than output power, it means you can get three times as much signal with class C.

Because of the extreme distortion and resulting need for tuned circuits, class C amplifiers are normally used only for rf power amplifiers. However, many computer circuits normally described as being "digital" or "binary" can also be considered as class C amplifiers operating on dc signals rather than rf.

In addition to the three major operating classifications of A, B, and C (class AB is considered to be a cross between A and B), another operational classification is used to indicate whether grid current flows in the amplifier. This classification consists of a numeric suffix applied to the classification letter; a "1" indicates that grid current does not flow, while a "2" means that it does.

Normally, class A amplifiers are A1, and class C amplifiers are C2. Most class B amplifiers are B2. The only place the number has great meaning is with class AB, where about as many circuits operate AB1 as do AB2. However, the presence or absence of grid current does not necessarily go with the operating class in all cases. It's quite possible to design a class A2 amplifier, which permits grid current to flow and yet operates class A, or a C1, which operates class C without any grid current.

At this point it might be well to point out another basis of classification often used, that into "linear" and "nonlinear" amplifiers (Fig. 6). A linear amplifier is one which amplifies its input signal without introducing any distortion, while a nonlinear one does introduce distortion of some type. Since nothing is perfect, all actual amplifiers are nonlinear to some degree, and therefore the term "linear" is always used in a comparative sense. A good

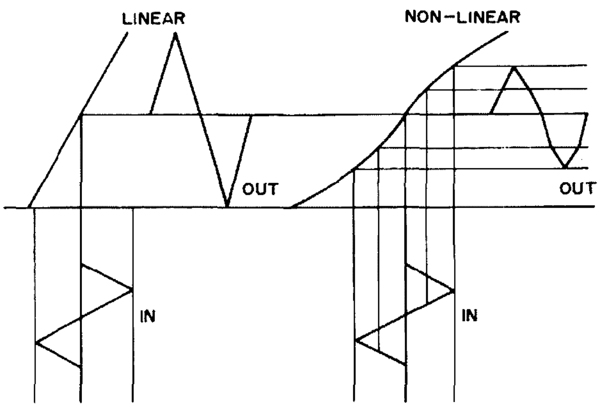

Fig. 6. Here we have linear and nonlinear amplifiers compared, with triangular signal waveforms instead of sine waves to make life easier for our illustrators and bring out the differences which are not obvious with sine waves. Linear amplifier, left, faithfully reproduces input signal at output. Nonlinear amplifier, right, puts bends into the straight sides of the waveform. These bends represent second-harmonic distortion. In general, any distortion is described as "nonlinear" operation.

hi-fi amplifier is linear, for instance, even though it does have some small percent distortion. In speaking of rf amplifiers for modulated signals, the distortion is measured with respect to the modulation rather than the individual rf cycles, and so a linear rf amplifier is one which does not distort the modulation rather than one which does not distort the individual cycles of the input signal.

The linear/nonlinear classification helps us to list the ways in which class A, B, and C amplifiers are used. For instance, almost all linear audio amplifiers operate in class A, which squares with the "amateur" definition of class A as being a linear amplifier. Many rf linears at low power levels also operate class A, and in general the class A operation is used almost exclusively when very low distortion is required. Most receiver circuits are class A.

Class AB and B amplifiers are widely used to produce moderate power levels with limited distortion. The output stages of many public-address amplifiers and almost all hi-fi power stages operate in class AB, and almost all SSB final linear amplifiers run as either class AB or B. In addition class B amplifiers are sometimes used in

battery-operated equipment to conserve battery power; many transistorized portable radios use class B output stages for this reason.

Class C operation is confined almost exclusively to rf power amplifiers which can be nonlinear; this means, in practice, all rf power stages in a CW or FM transmitter, as well as in an AM transmitter which uses high-level modulation (if modulation is applied before the final output stage, all the following stages must be linear, requiring A, AB, or B operation). Class C is hardly ever used in SSB transmitters, since the nonlinearity would destroy the modulation of the signal.

How and Why Do Amplifiers Misbehave?

Amplifiers, like all other physical objects, faithfully follow Murphy's First Law that says, "If anything can possibly go wrong, it will." In consequence, they continually misbehave. Fortunately, an amplifier is a relatively simple device, so that only a few things in them can possibly go wrong, and the result is that most amplifier misbehavior can be traced to a fairly small number of possible causes.

However, any specific case of "wrong-going" may be due to not just one but several of the possible causes all acting together, which sometimes makes it difficult to find and fix the trouble.

One of the first things which can go wrong is for the specific amplifier to be badly designed; in this case the designer has failed to take into account all the tricky little interactions which can affect his circuit's operation, and you as an operator are just about hopelessly lost. The cure is to forget it, and start over with a properly designed amplifier (if you're the designer as well, then it's back to the drawing board with our sympathy).

Since this kind of problem, though it's the most common in the case of new or one-of-a-kind circuits, is not within the range of the FCC exam, we'll ignore it the rest of the way in and assume that the misbehaving amplifier was properly designed and built and did, in fact, work perfectly at some time before the troubles began.

Another frequent wrong-goer is the user of the equipment; in this case nothing at all is wrong with the amplifier itself, but it's being used under conditions which never were intended by the designer. This is the most frequent cause of amplifier misbehavior – and we'll get back to it in much more detail a little later.

The final frequent cause of trouble is failure of one or more components in the circuit. A blown tube or transistor is relatively easy to find and fix – but a bypass capacitor which has changed in value (because of age or overheating) just enough so that it no longer does its job properly may provide more than its share of hair-pulling before it's detected.

From the standpoint of the operator, the only one of these three probable causes of problems which he can do anything about is the second – misuse of the equipment. The cure for the first is to redesign the circuit, and for the third is to locate and repair the defective part. While both of these are legitimate activities for a radio amateur, neither of them is involved directly with the *operating* of the equipment.

Because of this, and also because misuse accounts for most of the amplifier problems and bad signals in existence at any one instant, we'll concentrate on just the one problem.

Before we can talk about "misuse" of an amplifier, we must know what the proper use for that amplifier is. For instance, the purpose of a linear power amplifier used to bring a single-sideband signal from 10W up to 500W is defined, and "proper use" of this particular rig would be that use which accomplishes the power amplification without distortion and unwanted spurious output signals.

In general, the amplifier's name (such as "linear," "power," etc.) together with the designer's specifications for input and output levels will tell you all you need to know about the circuit's purpose, and proper use amounts to "that use which accomplishes the purpose of the circuit."

Misuse, then, can be defined as any use which defeats the circuit's intended purpose. In most cases, this boils down to one or more of three major mistakes:

1. The amplifier is adjusted to operating conditions such as bias or voltage levels which are outside the range anticipated by the designer.

2. Input signals are applied at levels either lower or higher than the range intended by the designer.

3. More output is attempted than the designer intended the circuit to produce.

Let's see how these three mistakes affect several typical amplifier circuits. For starters, let's see what happens when a class A amplifier intended for low-distortion amplification of an audio signal is misused. Such an amplifier might be in the speech-amplifier chain of any phone rig, or in a receiver.

If the amplifier's bias can be adjusted, and is set to a value higher than the designer intended, the stage will draw less current than it was designed for, and so cannot develop its rated power output (or voltage output, if it's a voltage amplifier).

Similarly, if the bias is set too low, a "normal" input signal may overcome the bias and change the operation condtion from class A to class AB. The effect of bias adjustment, then, is to reduce the allowable input and output signals –,and if the value is very far from the intended level, excessive distortion may be introduced into all signals (Fig. 7).

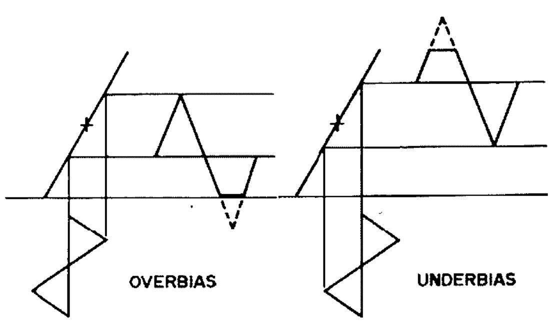

Fig. 7. Shown here are the effects of overbias and underbias on a class A amplifier, with a triangular input signal of maximum rated level which could be reproduced linearly were the bias proper as indicated by the "X" in the center of each amplifier transfer line. Overbias causes the negative-going peaks of the signal to "bottom" against the cutoff point, which is actually class AB operation, while underbias causes amplifer to saturate and flat-top the signal.

However, in most class A amplifiers, the bias level is not adjustable by the operator, so this particular example won't be met often in practice.

If the input signal is out of the range intended by the designer, other bad things happen. If the input signal is too weak, the probable effect would be simply low output, possibly contaminated with noise, but most class A amplifiers are intended to work with signals which range right down to the noise level anyway, so the designer has probably intended his circuit to work with input signals approaching zero volts. When grid current flows, the input signal is distorted before it ever reaches the active device, and the distortion can't be removed later. Even if grid current does not flow,it's possible to "saturate" the active device so that it no longer changes in resistance as the input signal changes, and this too leads to distortion.

Meanwhile, the negative-going peaks of the input signal add to the operating bias, and may add to it enough to change the operating conditions to class AB instead of class A. This also produces distortion in the output signal.

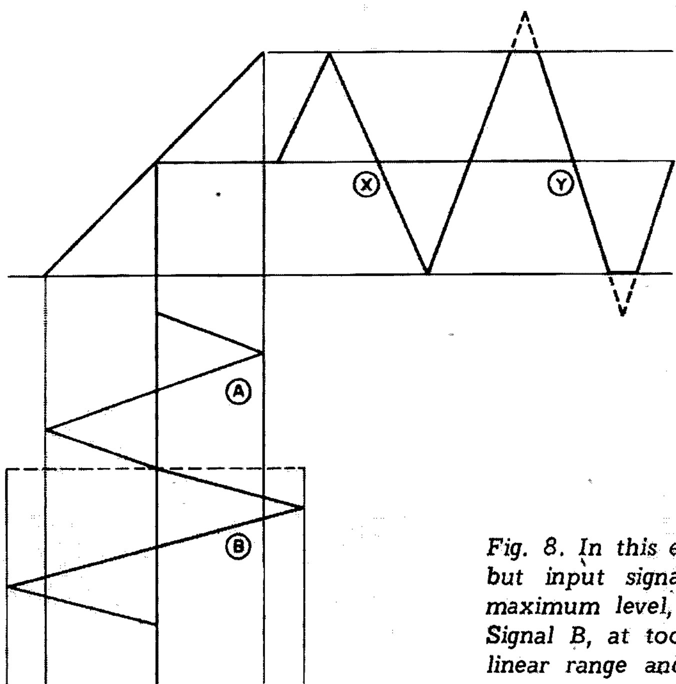

Fig. 8. In this example the bias is properly set but input signal is excessive. Signal A is at maximum level, and produces linear output X. Signal B, at too high a level, runs outside the linear range and produces distorted output Y with both bottoming and flat-topping evident.

Too much input signal, on the other hand, produces all sorts of ill effects, and you can find horrible examples all over any of the bands.

When input signal level in a class A amplifier is too high, either or both of two problems arise (Fig. 8). The positive-going peaks of the input signal completely overcome the amplifier's operating bias, which permits grid current to flow. If the designer has intended grid current, and allowed for it, this is not in itself bad – but most class A amplifiers are not meant to be used this way, and so grid current in 99 out of 100 of them indicates excessive input signal.

An oscilloscope will show you which of these two problems is present in an amplifier. If the positive peaks are causing the problem, the voltage waveform of the output signal will tend to be flattened off at its *negative* peak; if it's the negative peak of the input signal doing the dirty work, the output signal will be flattened at its positive peak.

In either case, the cure is simple: reduce the level of the input signal. The normal control for doing so is the audio gain control on the transmitter panel, or the volume control on the receiver. If your transmitter has no audio gain control (and

many do not) you can either speak a little more softly, or connect an attenuator pad (a sort of resistive voltage divider) between the microphone and the amplifier.

What about the output conditions? In our class A amplifier, which is normally used to provide voltage gain, this isn't usually adjustable. If it were, taking too little power out would tend to produce the same symptoms as putting in too much input signal, while attempting to get out too much power would show up as heating of all the amplifier components in addition to distortion.

Now let's see what happens when we misuse a class C rf power amplifier. For openers this time, we'll assume that it's the final output stage of a CW transmitter.

In many class C amplifiers using "fixed" bias, the bias level can be adjusted by the operator. Too low a bias level will result in low power output, and too high a bias level will generate excessive harmonic output. Most class C circuits these days, however, use a "self bias" arrangement in which the operating grid bias is developed by the flow of grid current through a "grid leak" resistor; with these, both the bias level and the input signal are set by the same control, which may be called the "drive" adjustment, or the "driver tuning."

Input signal level is not as critical with a class C amplifier as it was with class A, because we are not so concerned with signal distortion. The main thing is to have enough, without overdriving the circuit, and the designer usually specifies a broad range of operating conditions.

In circuits using self-bias, loss of drive causes loss of bias as well, with resulting high current in the amplifier stage and damage to all components in the plate circuit. For this reason it's good practice to adjust the drive level (input signal) with the amplifier plate and screen voltages turned off. If input signal is too small (too little grid current), bias will be too low and power output will be low. If it's too large (excessive grid current) harmonics will be excessive and the final-stage grid may be damaged.

With a CW transmitter, it's best to start with the amount of drive signal the designer recommends. After drive is developed, plate voltage may be applied and the output adjustments made, and then drive may be reduced until power output drops by a barely perceptible amount, and advanced by some 15 to 20% from that point. This assures minimum drive while still providing rated output from the amplifier, and will probably result in an input signal level within the designer's intentions.

For an AM transmitter, this adjustment of drive and loading may not be adequate. A modulated amplifier requires enough drive to supply the modulation peaks as well as the carrier level, but we'll go into that later when we examine the modulation process.

Output signal level adjustment in a class C amplifier is the most critical adjustment of them all. It should not be attempted until the input signal level has been brought into the correct range, because the tube or transistor may be destroyed in the absence of input signal.

Most transmitters have two adjustments for output tuning, one marked "tuning" and the other marked "loading." The normal practice is to set the loading control for minimum output, then rapidly adjust the tuning control until plate current dips sharply. This dip indicates that the output tank circuit is tuned to resonance, and is acting as a high impedance.

While this is all right for tuneup, which normally is done rapidly, it can damage the equipment if extended operation is attempted with too-little power being taken out. Whether you use it or not, a 500W amplifier is developing its 500W worth of current and voltage swing, and if you take only 50 of them out, the rest are going to be looking for mischief inside the amplifier. Tuning coils may overheat and melt their plastic supports, or capacitors may arc over.

To take more power out, the loading control is adjusted to increase plate current, meanwhile readjusting the tuning control to keep the dip at its minimum value. The readjustment is necessary because the two controls interact; increasing the loading reduces the "Q" of the tank

circuit, and changes the reactance at the same time. This process should be continued until the amplifier is producing its rated output, and then halted.

It's possible to load most class C amplifiers until the dip disappears, but if you check with an indicating wattmeter you'll find that pretty shortly after rated power output is reached, the output power begins to fall off even though the indicated input power keeps climbing. The extra power simply goes into the amplifier to be dissipated as heat, and can damage all the components.

Notice that while "distortion" was the key result when a class A amplifier was misued, "equipment damage" is the key result in class C operation. The tipoff to problems in class C is excessive plate current. If excessive plate current can be controlled by the tuning and loading controls, it probably indicates an attempt to get too much power out of the rig. If not, it probably indicates loss of operating bias, which can be due to loss of input signal.

Of course, a badly designed rig can draw too much plate current for other reasons. If the amplifier is subject to oscillation, either self-oscillation near the operating frequency or parasitics at far removed spots in the spectrum, this can cause excessive current. Similarly, component failure which removes the input signal can cause it. But the most common cause is simply trying to get something for nothing.

How about the "linear" used with an SSB transmitter? These rigs have a reputation for being tricky, but actually they're little if any more complex than a class C rig. The major difference, in fact, is that their designers set them up to operate in class AB, and to produce as little distortion as possible between input and output.

Since the bias level is the major factor controlling which class a specific amplifier is operating in, the bias of a "linear" amplifier must be set to the level specified by the designer. Most such amplifiers have a bias control accessible to the operator, which is intended to be adjusted for some specified value of plate current with no input signal applied. If bias is too low (too much plate current), the power capabilities of the amplifier will be reduced, and if it is too high, distortion will increase.

The input signal, also, is critical – but only at the upper end of the range. Linears are designed to accept input signals down to zero, but the maximum input signal level must not be exceeded if operation is to remain linear. Too much input signal (overdrive) causes distortion just as it does in a class A amplifier, with flattened peaks. In an rf amplifier, this distortion shows up as illegal harmonics outside the ham bands, as well as "splatter" and "buckshot" which may be within the bands but is not within the channel you are using. Such spurious signals are prohibited by FCC rules. The distortion produced by overdriving a linear amplifier is sometimes called "flat-topping" the signal, but overdrive is not the only cause of flat-topped signals.

Misadjustment of the output level can also cause flat-topping and other distortion problems. A linear amplifier is more critical in its output adjustments than in any other. In order to develop rated power output, the active device (tube or transistor) must work into its rated load impedance, and this impedance is set by the output tuning and loading controls.

If the adjustments are set for too little loading (less than rated output power), the load impedance will be too high and distortion will be produced. Similarly, if the amplifier is too heavily loaded, distortion will also result. Too heavy loading produces less distortion than too light loading, however, so in case of doubt it's best to err on the side of too much loading. This should not be confused with too much output – overdriving in an attempt to get more than rated power out is a sure way to generate a bad signal.

The distortion produced by underloading shows up as "peak clipping" which is a form of flat-topping. That resulting from overloading is "intermodulation" which can put the unwanted sideband back into the signal. To guard against such problems, most operators tune up linear amplifiers with the aid of an oscilloscope, which can show them the proper combination of all input and output level adjustments. ...Staff■

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Phone Patch Level Adjustments and Manproofing

Now that phone patches are legal, amateurs are given the responsibility to adjust the levels they feed into the lines of those phone systems that do not furnish or have not got interface black boxes to automatically adjust patch injection levels. Failure to adjust the levels may overdrive the phone lines and cause undesirable crosstalk on other phones sharing the same cable. Since this is usually your neighbors, crosstalk, like TVI, is close to home.

The procedure for adjusting your patch injection level is relatively simple, and may be done to a practical degree of accuracy with any ac voltmeter which can read as low as 1.5V full scale.

First, you should understand that there are two line wires and a floating ground in most phone systems. You are only interested in the line wires, and these are generally coded green and red. In any case you can find these two with a voltmeter, since there is a residual dc voltage on the line.

To calibrate your ac voltmeter to your phone's reference level, connect a 0.1 μF capacitor in series with one lead, to block the dc but pass the ac. If your multimeter has an OUTPUT setting, use that since such a capacitor is inserted internally. Use your lowest ac scale. Then take the phone off the hook and dial the first 3 digits of your own phone number. This will drop the dial tone and give you a clear audio line. Talk into the phone in a loud voice – a little louder than you talk on the phone normally. You will see the meter needle kick up to about 0.5V. Notice where it kicks up to as you talk, and then hang up the phone. You have now established your reference point.

To adjust the patch level, tune your receiver to a good QRM-free signal on the band, choosing one that causes your S-meter to at least show some value larger than S2 or so. Again dial the first 3 digits of your number, and flip the patch into the line. Adjust the receiver audio gain until the ac voltmeter on the phone line kicks up about the same as it did when you calibrated it with your own voice.

When completed, mark the audio gain now at the setting you found proper for your patch. This will be the correct level for all patch use, regardless of signal S value, because any decent SSB rig holds the audio output level sufficiently accurately, through it's normal agc action, to suffice for phone patching use. If you want more precision, however, you can leave some form of capacitor-isolated meter on the patch, as a sort of VU meter.

Do not omit the capacitor, and preferably use one in each lead to prevent shorting the phone line if you have an accident with the leads.

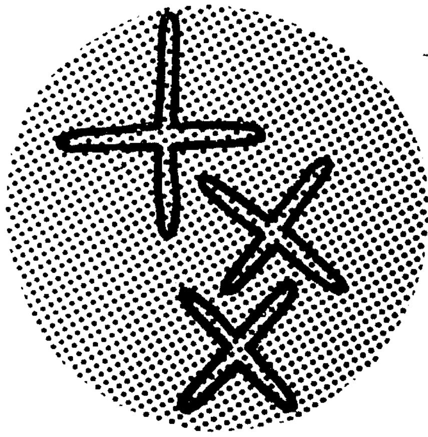
Manproofing the Patch

If you want to make your patch foolproof, you can do this to the extent that nothing you do on your patch will cause your phone to be out of service, nor prevent its use in a normal manner. To do this, do not connect your attachment wires

directly to the phone wires. Instead, put a small electrolytic capacitor in both leads, right at the attachment point. The capacitance of these should be 2 or 4 μF each, and polarize them right so they block the dc on the line. This is done by finding out which phone wire is positive, and connecting the positive lead of one of the electrolytics to this phone wire, and connect the negative end of the other capacitor to the other phone line. Now, connect the two patch wires to the two dangling ends of the electrolytic capacitors. You can now short the patch, leave it on, etc, and you will not load the phone enough to cause more than a small decrease in its loudness.

A 2 μF capacitor is about the best value, since this causes an effective 1 μF total series capacitance in the patch line, which causes a 3 dB cutoff frequency of 300 Hz on the 900Ω line. This is an optimum match to an SSB receiver. If you decide to use these manproofing capacitors, install them before you calibrate the audio gain for patch injection, for better accuracy.

. . . W4NVK ■



WOULDN'T YOU LIKE TO GET INTO RTTY ?

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Most people think RTTY is very expensive – that it takes a lot of technical skill to get rolling. Actually, provided you have a transmitter and a receiver (or transceiver that does not drift) you can get started for about $100.

You will need three basics: a teleprinter with keyboard, a terminal unit, and a simple frequency shift keyer on your transmitter vfo.

A basic teleprinter like the Teletype Model 15 will cost about $75. This is where most of your investment will be. This unit will, with the addition of the terminal unit and frequency shift keyer, enable you to transmit and copy RTTY. A block diagram of a basic RTTY station is shown in Fig. 1. Note that the terminal unit (sometimes referred to variously as a TU, converter, or demodulator) hooks between the teleprinter and the audio output of your speaker.

The purpose of the demodulator is as follows:

The receiver picks up two alternating tones, one relatively high pitched and the other a little lower. The lower tone is called mark and the other, space.

Different combinations of mark and space tones correspond to specific letters, numbers, and punctuation marks.

The TU has a 150V, 60 mA "loop current" passing through it and the two electromagnets in the teleprinter known as selector magnets. As alternating tones come through the receiver the TU causes the loop current to go on and off in a definite pattern corresponding to each letter received. As the loop current is broken up, the machine prints the message.

On wide-shift systems, the frequency of the mark tone is 2125 Hz and the frequency of the space tone is 2975 Hz. With narrow-shift, the mark is 2125 Hz but the space signal is 2295 Hz (a difference of only 170 cycles).

To get these tones you put on your product detector as if for CW and tune in the RTTY signal for the correct tone frequencies with the aid of an oscilloscope. When the pattern on your scope is as shown in Fig. 2 the signal is tuned in correctly. Figure 3 shows tuning too low and Fig. 4 shows tuning too high.

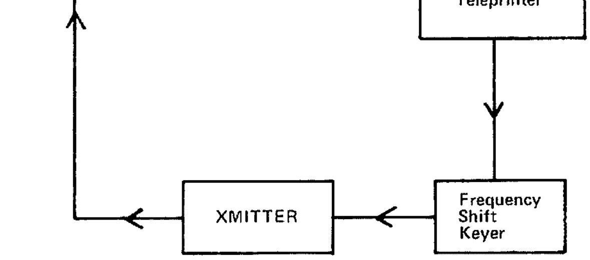

Fig. 1. Block diagram of RTTY station.

Transmitting RTTY

For transmitting, the keyboard is hooked up to the FSK circuit in your transmitter vfo. When a key is pressed the FSK circuit keys the vfo up and down in frequency with a definite pattern corresponding to the letter on the keyboard. There are many ways of doing this.

One way is to put the keyboard in series with the selector magnets. Then when a key is pressed the loop current is broken up the same way as when the TU breaks up the circuit on receiving. The loop supply in turn keys the FSK circuit.

Auto-Start

Some hams who have a net frequency (mostly on VHF) use a method called Auto-Start, which can prove quite handy. Suppose one person wants to send his friend a message, and both are on a net frequency. The friend leaves his receiver and terminal unit on 24 hours a day. The person who wants to send the message sends a five-second, steady mark (2125 Hz) signal. The receiver on the other end picks this up and the terminal unit which has a special Auto-Start circuit in it automatically turns on the motor in the teleprinter. The sending station then sends the message. At the end of the message he sends a steady five-second space signal (2975 Hz) to shut off the other station's teleprinter motor. The sending station then turns off his carrier. When the man returns from a hard day at work he goes up to his shack and reads what his friend has sent him during the day. He can reply in the same manner.

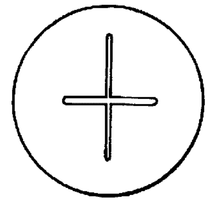

FIGURE 2

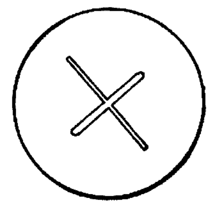

FIGURE 3

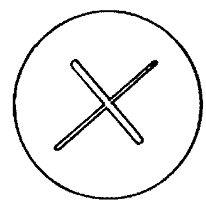

FIGURE 4

Figs. 2, 3, 4. RTTY scope patterns.

Where to Get More Information

I suggest, for those interested in getting more info on RTTY that they refer to handbooks by 73 and CQ magazines. They would also do well to get a copy of the RTTY Journal. It is put out by 'Dusty' Dunn W8CQ, PO Box 837, Royal Oak, Michigan 48068. Subscription rate is $3 a year.

. . . WB2TCC ■

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PERF-BOARD TERMINAL

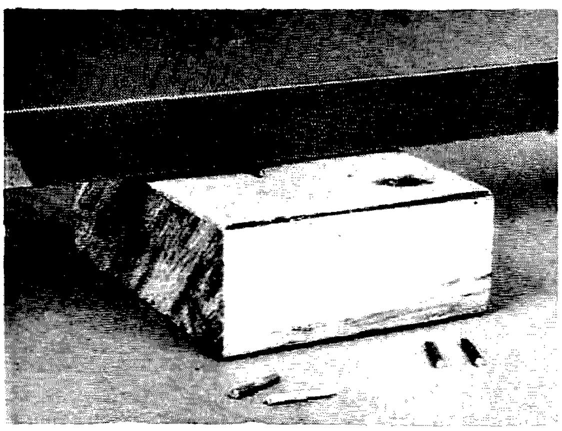
Having successfully used the type of Vector board with 3/32 in. perforations and the relatively large T9.4 terminals in several projects, I decided to try the type with 1/16 in. perforations and the small T28 terminals for more compact circuitry when recently building a frequency counter. The counter consisted mainly of integrated circuits and a great deal of interconnecting wiring, with up to four or five wires plus the IC being connected to a single terminal. The T28 terminals didn't seem to be very well suited to my purpose, so after some experimenting I came up with this substitute. It is a simple pin-type terminal that is inexpensive, easy to make and use, and better suited for some purposes than the T28 terminals.

Making the terminals

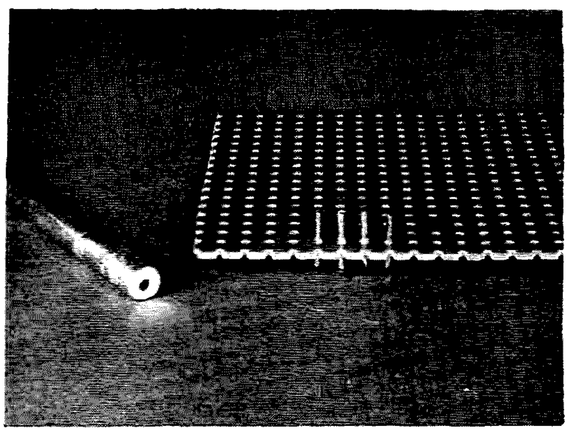
The terminals are made of 14-gage bare or tinned copper wire. Insulated wire is available at any hardware store, the least expensive being type TW. The plastic insulation is easily peeled off with a pocket knife. Clean the wire with fine sandpaper if it is tarnished or dirty.

Cut the wire to the length desired for the terminals. I found that a ½ in. length worked well for me. To easily cut a large number of terminals to exactly the same length, simply drill a 5/64 in. (diameter) hole in any convenient material to a depth equal to the desired terminal length. Then you merely insert the wire, clip it off flush, and allow the terminal to drop from the hole.

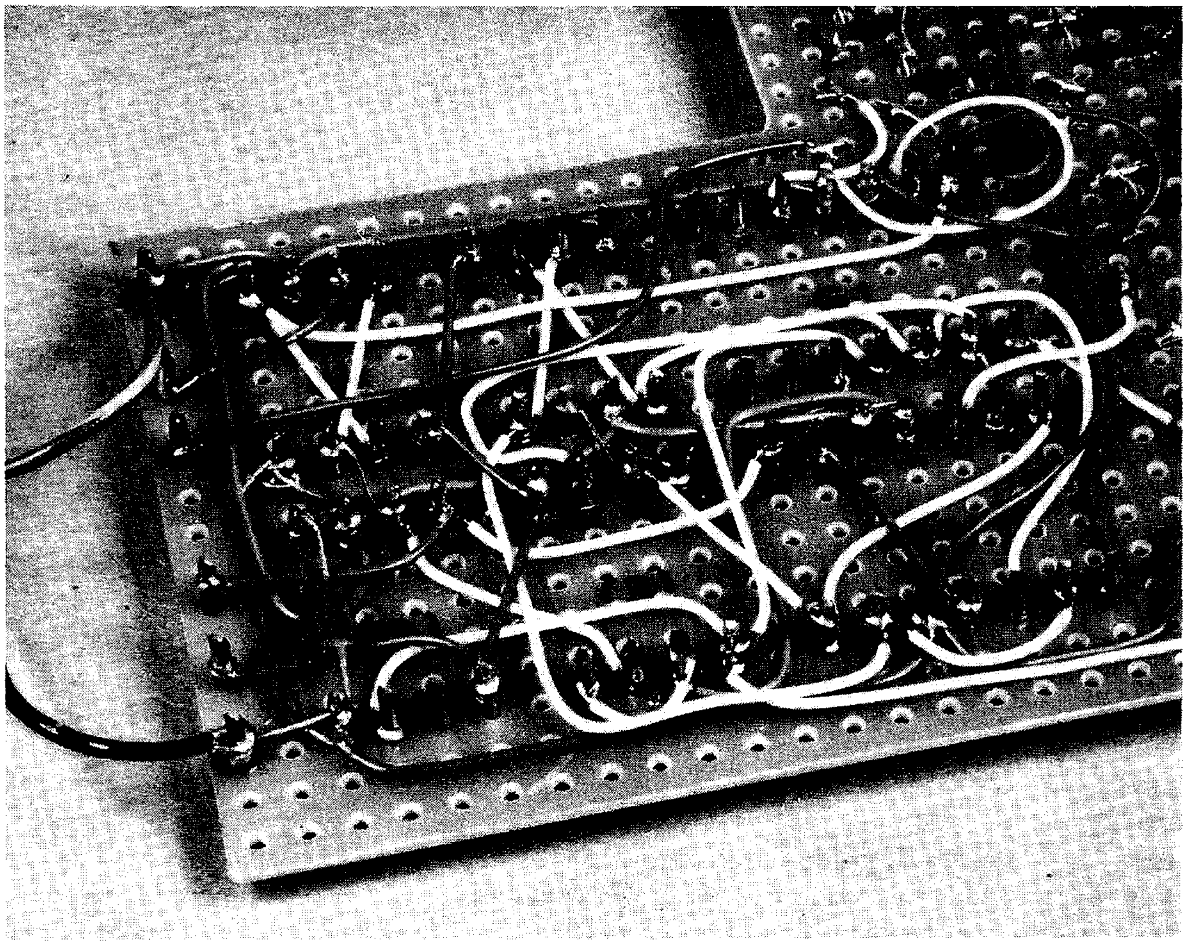
The 14-gage wire is a loose fit in the 1/16 in.-diameter board perforations, so it must be expanded slightly to make it a snug fit. This is done by knurling it lightly at the point where it will contact the board. Place the terminal on a small block of hard wood. Press down on the proper part of the terminal with the edge of a flat file. Move the file back and forth so as to roll the terminal beneath it. A few strokes



The terminals are knurled by rolling them under a file.



The terminals are easily inserted with a simple tool.



The wiring side of a board from the author's frequency counter, in which over 600 of the home-made terminals were used.

using moderate pressure will raise a series of ridges such as those found on the edge of a dime, and will make the terminal a tight fit in the board. I used an 8 in. file that had an edge width of 3/32 in., but any medium-cut flat file should work.

The terminals are easily inserted into the board with a simple tool. Take a piece of metal rod about 5 in. long and drill a 5/64 in. hole in one end to a depth equal to the length of terminal that will protrude from the board. Then place the terminal in the board, lower the tool onto the terminal, and press down firmly. Be sure to support the board near the terminal while doing this.

Advantages and disadvantages

The main advantages of using this terminal are that it will hold a large number of wires without difficulty, and you can wrap a wire around it and squeeze it tight with pliers without crushing the terminal. Also it is easy to make a good solid solder joint because of the large contact area between the wire and terminal. The removal of a wire is very easy, even if it is at the bottom of a stack of three or four. Just heat the joint and slide the wires straight up and off the smooth surface of the terminal. The wire ends will keep their shape and can be slid back on and resoldered.

The T28 terminals are better for holding small resistors and capacitors, and require less heat to solder than the homemade type. More care is necessary, however, to prevent cold solder joints if several wires are to go into one slot.

The homemade terminals are very inexpensive, costing about 12 cents per 100, but the time involved in making them probably nullifies any saving. In the frequency counter previously mentioned I used over 600 of the homemade terminals and about 40 of the T28 terminals, with each type doing its particular job very well.

. . .K5LLI■

John G. Harder W5QKO/AI4QKO
6200 Air Base Wing
APO San Francisco 96274

TUNING ALL-BAND VERTICAL ANTENNAS

A vertical actually makes a pretty good antenna, provided your match allows you to radiate the signal you put into it.

All-band vertical antennas are inexpensive space-savers which can do a surprisingly good job at their best, but often give disappointingly bad results. Newcomers are often attracted to these antennas by the cost savings over more complicated arrays, but many encounter considerable frustration in the attempt to make the unit perform as it is supposed to.

An example of this type of continuously tuned antenna is the WVG Mark II. It is basically a multisection aluminum whip in an insulated mounting which attaches to a short length of pipe for ground mounting or to a piece of TV mast for rooftop use with radials. The unit is supposedly designed to be fed with 52Ω coax. The coax shield connects to the ground rods or radials. The center rf conductor of the coax is normally tapped down on a loading coil to achieve resonance at the frequency in use, while simultaneously providing a satisfactory impedance match to the coaxial line. On 20 and above, the whip alone is usually used with direct coax feed.

Practically speaking, this procedure seldom produces a match which permits anything like a truly efficient transfer of power from the feedline to the antenna. It doesn't take much knowledge of antenna theory to understand that if the power doesn't get into the antenna, it doesn't get radiated. On some bands the coil and whip may show resonance at the desired frequency when checked with a grid dip meter, only to prove unusable because the impedances are still mismatched.

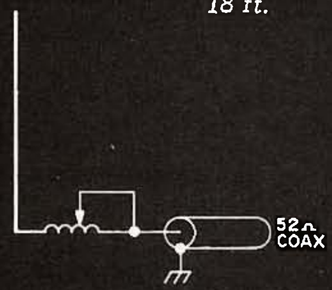


Fig. 1. Antenna as supplied by manufacturer, whip length 18 ft.

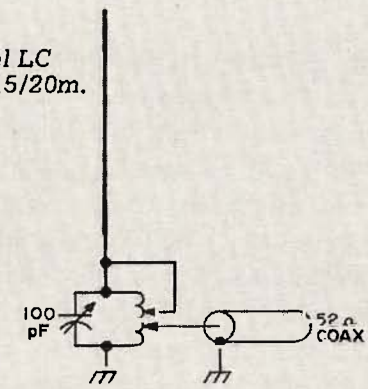


Fig. 2. Parallel LC network for 15/20m.

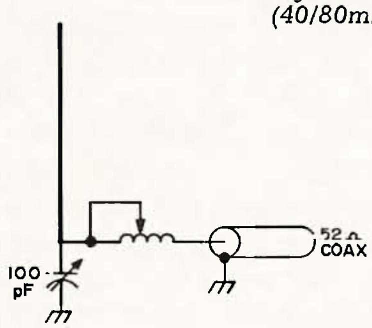


Fig. 3. L network (40/80m.)

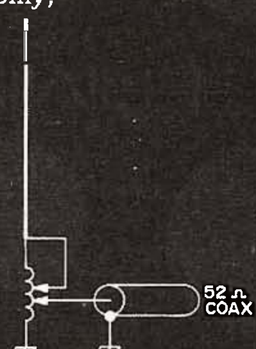


Fig. 4. Tapped coil only; usable on some frequencies.

While some equipment *will* load into a line with a vswr of greater than 2:1, most manufacturers these days specify low vswr to avoid such conditions as overheating of TV sweep-tube finals and radiation of rf from the transmitter cage. The answer for some is to give up and try a more expensive antenna, such as a trap vertical. But before spending those dollars, why not try to do a better job of matching than the coil can do alone? This can be achieved by simply adding a small variable capacitance at the feedpoint, using clip leads to allow it to function as part of an LC network in series or in parallel. Using an additional tap on the coil will allow the 52Ω feed to be matched more accurately.

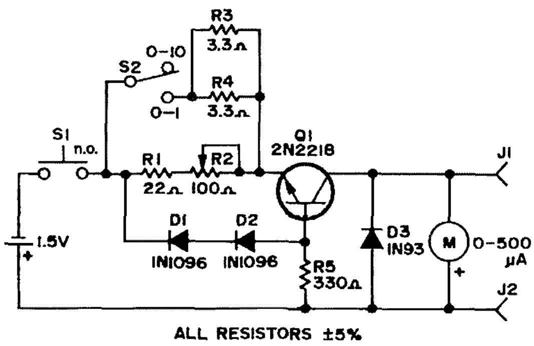
The exact amount of L and C needed for resonating and matching at a given frequency will depend mainly on the type of mounting and ground system in use. Before trying the matching network idea, I found that a vswr of 2:1 was the best obtainable on several bands. On 15 meters, the antenna was completely unusable with a vswr over 3:1. It was of course possible to adjust the whip length for 15m, but band-changing became a major chore.

After use of the matching network, the results were very satisfying. It was possible to reach less than 1.3:1 on all bands, and I found that by proper placement of the coil taps I could go from 15 to 20m with just a twist of C alone. This convenience was well worth the effort.

After matching with a standing-wave bridge connected at the feedpoint, all I had to do was mark the coil taps and positions of C, and band-changing was now possible in a matter of seconds. Besides all this, my first QSO after the job was done resulted in a good report from UAØKFG with only 150W input at my end!

Possible refinements include mounting of the whole network in a waterproof container such as a refrigerator box or plastic 3 x 5 card file that includes its own hinged lid. By careful choice of methods shown for setting up the network, your antenna will now work efficiently on any band from 80 through 10m and on MARS frequencies in between.

...W5QKO/AI4QKO■



The Low-Ohm Meter

A. Schecner W3YZC
122 Sherry Lane Apts.
Conshohocken, PA 19428

Did you ever try to get a good resistance reading on a speaker voice coil? Or an automobile ignition ballast resistor? Or a pilot light bulb, length of coax, relay contact, loading coil, identifying transformer windings, centertaps, etc.? If you have, then you've found that most ohmmeters don't have a really low resistance scale – or if they do the zero setting is unreliable and the meter scale inadequate. After years of annoyance from this problem I finally decided that a low-value ohmmeter would be a handy device to have around. In fact, applications for this meter just seem to suggest themselves. Why bother building a new version of an old instrument and not incorporate new innovations? So I came up with these requirements:

- No zeroing knob – just a "set it and forget it" calibration control.
- Linear scale reading from zero to a fixed value, rather than to infinity. What good is infinity to an ohmmeter, besides making the upper 25% or so of the scale relatively useless?
- Solid terminal connectors rather than wires with probes (optional). This would prevent poor contacts in the circuit, leading to error.

The finished version uses one size D flashlight cell, has two scales – zero to 10Ω, and zero to 1Ω. A "test" switch (momentary pushbutton) is used because of the high current requirement of the circuit. Battery life is conserved in this way.

Theory of operation

The circuit consists of a constant-current generator (Q1) to provide a known current through the test resistance. The voltage drop across this resistance (100 mV maximum) is read on a meter whose internal resistance is much higher than a test resistance of 10Ω. Therefore, the meter does not load the circuit.

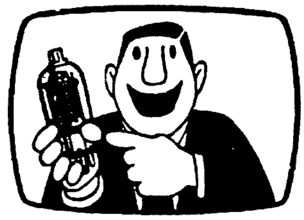
A bias for Q1 is established by diodes D1 and D2 and resistors R1, R2, R3, R4, and R5. Use of the diodes holds the bias level constant despite nominal decay of battery voltage. Diode D3 prevents severe overload of the meter in the absence of a test resistance. In case the test button is pressed, the meter will overload, but not much, thanks to D3.

My meter was obtained when I scrapped a Heath grid-dipper after buying a solid-state model. The meter requirements are 500 μA full scale, 200Ω resistance. A substitute may be constructed by using a more sensitive meter with a shunt, so long as the result is 500 μA, 200Ω.

Construction

Layout is not critical, but solder connections *must* be solid and medium bus wire must be used. The battery connector must make tight connection with the battery. Check internal resistance by shorting the test terminals with heavy wire. Pressing the test button should give a reading of zero.

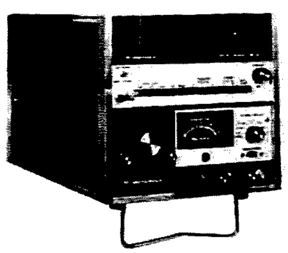
Transistor Q1 may be replaced by any one of a number of high-beta NPN types. Try what you have around and see if it works. R2 may be used to balance slight differences if another transistor is used. Calibrate by testing a precision 10Ω resistor (0–10Ω scale) and setting the calibration control for a full-scale reading. The other scale should follow automatically.



NEW PRODUCTS

Digital Frequency Meter

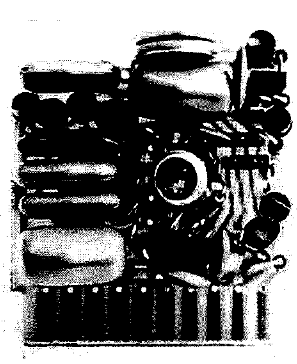
Motorola has introduced a new digital frequency meter, the S-1325A, with 50 mV sensitivity and eight-digit readout. The unit provides continuous frequency coverage from 50 Hz to 525 MHz in two ranges. The resolution and oscillator stability far exceed FCC requirements of two-way radios, making the unit truly obsolescence proof. The advanced modular integrated circuit design assures simple, reliable operation and ease of maintenance. A built-in deviation meter provides



total servicing capability for frequency and FM deviation measurements. For complete technical specifications, write *Motorola Communications and Electronics, Inc., 1301 East Algonquin Road, Schaumburg IL 60172.*

Silent Sentry (SS-80H)

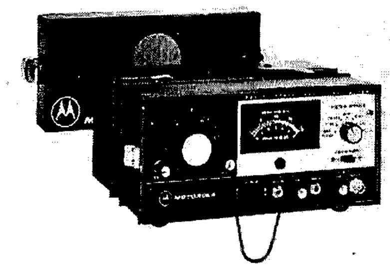
Because of increased demand for a reliable solid-state subaudible continuous tone encoder/decoder that is small enough to fit internally in portable and hand-held two-way radios as well as some of the very small mobile and base station models, Alpha Electronic Services has developed the SS-80H. Measuring only 1-1/2 x 1-1/4 x 1/2 in., it is believed that this is the smallest unit of its kind. The SS-80H meets or exceeds EIA specifications, and coupled with the frequency determining module (TN-91H), can be installed internally in equipment where space is a severe problem. Completely compatible with Private Line, Channel Guard, or other standard frequency tone quieting devices, the SS-80H also is available on special tone frequencies, allowing greater use of congested channels. Utilizing solid-state circuitry, this reliable accessory makes



possible more efficient use of two-way radio communications by relieving the user from listening to cochannel chatter. Easy installation instructions are available for all two-way radios and free engineering assistance is provided for unique or difficult applications. For information call or write *IAlpha Electronic Services Inc., 8431 Monroe Ave., Stanton CA 90680.*

Deviation Meter

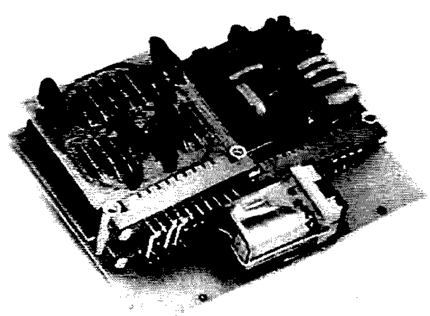
Motorola's S-132A portable solid-state deviation meter provides direct reading measurements for fast, accurate servicing of two-way radio and other communications equipment. The advanced design of the instrument eliminates the need for complicated setup procedures. Complete and self-contained with built-in local oscillator; no other accessories are required. Two carrying handles are provided, one on top of unit and one



on rear of unit. The Motorola S-1323A contains an accurate, linear, countertype discriminator and a heavily degenerative peak-to-peak voltmeter. A highly stable conversion oscillator provides accurate measurement to 1000 MHz with low inherent residual modulation and maximum freedom from drift. An IC audio amplifier drives a speaker built into the front cover of the unit permitting off-the-air monitoring. For complete technical specifications write *Motorola Communications & Electronics, Inc., 1301 East Algonquin Road, Schaumburg IL 60172.*

Dual-Frequency Subaudible Tone

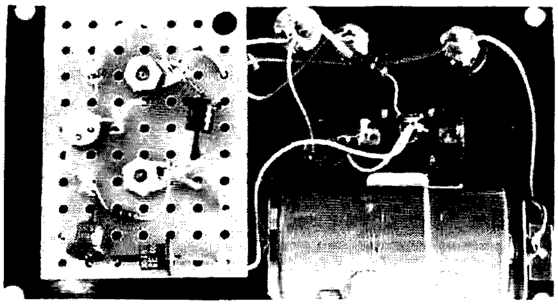
The Alpha DTSS-80 two-frequency transistorized subaudible continuous tone squelch system is exceptionally useful where there exists a need to have a choice of tone frequencies for the purpose of controlling or selecting repeater stations, base stations, or mobile radio units. By a simple two-position switch the dual tone makes possible the employment of multiple repeaters increasing the range capabilities of a radio communications system. The selective calling of two base stations, two groups of mobiles, or special control functions are other uses that this versatile device can accomplish. Each DTSS-80 tone unit is comprised of a plug-in encoder/decoder board and two plug-in TN-91 frequency determining boards.



A special model is available that plugs directly into GE's MASTR mobile radio umts. For information call or write *Alpha Electronic Services Inc., 8432 Monroe Ave., Stanton CA 90680.*

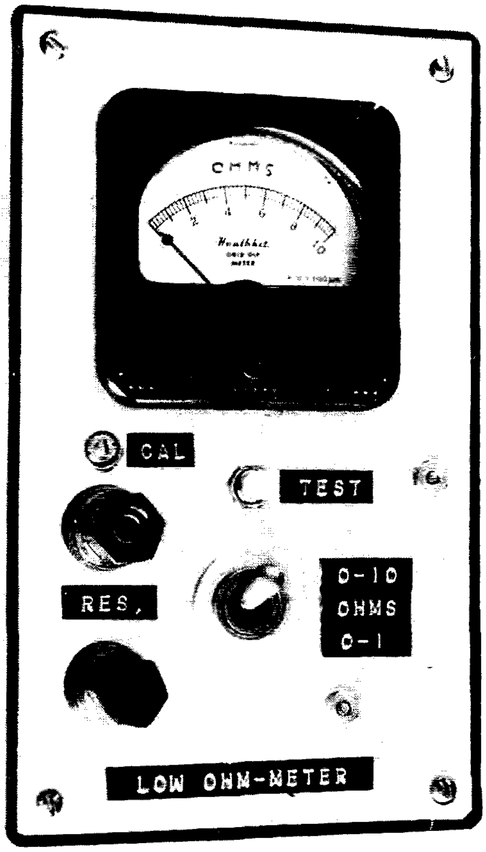
Two Capacity in CK06 Style

Capacitance values up to 2 μF can be obtained in the newest model Ceraseal ceramic capacitors. The new units incorporate the high capacities in a modified CK06 case style with a thickness of only 0.150 in. Previous capacitance values had extended only up to 1 μF. In the



Photos 1 and 2 show the meter built in a Bakelite box with aluminum panel. I have measured the resistance of a loading coil of a new Hustler mobile antenna and compared it to my old beat-up one. I planned to build a dipole out of the two of them and wanted to be sure everything was okay. Resistance of the probes I used was 0.2Ω, by shorting them together, the total reading (probes + coil) was 1.0Ω. Therefore the coils were 0.8Ω.

Other uses will suggest themselves. I hope you will find this novel instrument as useful as I have.



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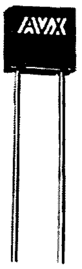
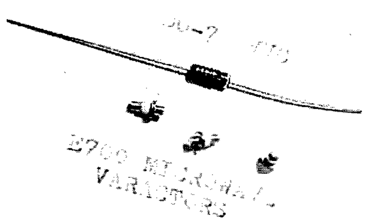


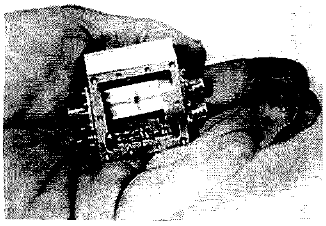
Ceraseal series, a ceramic case encloses the unit's active layers. A thin epoxy coating is applied to the finished unit for additional protection. Use of the ceramic case, which is formed as an integral part of the capacitor before firing, results in the production of a truly solid-state capacitor featuring monolithic construction combined with complete hermeticity for use in aerospace, computer, and military applications. *Aerovox Corp., New Bedford MA 02741.*

Amateur Radio Varactors

A new family of high Q varactors for amateur radio service in application from i-f's up through 450 MHz. These varactors now make practical very compact equipment by replacing mechanical tuning with electronic tuning. Amateur uses include AFC, incremental tuning of transceivers, remote control, and simplified frequency modulation. Application notes and data sheets are available from the manufacturer. Prices range from $1.50 to $6.50 in small quantities. *Eastron Corp., 25 Locust St., Haverhill MA 01830*



Double-balanced MIC Mixers



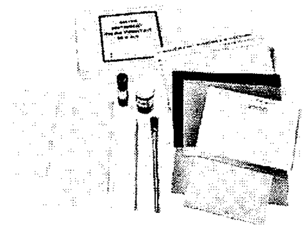
A new series of double-balanced MIC (microwave integrated circuit) mixers combines low-noise performance and wide bandwidth. The mixer-preamplifier (illustrated) provides multi-octave bandwidths, low IM distortion, and beam-lead Schottky diodes. Available with hybrid IC preamplifiers as well as discrete component units. *RHG Electronics Laboratory, Inc., 94 Milbar Blvd., Farmingdale NY 11735.s,*

1971 Technical and Scientific Book Catalog Available

An 80-page catalog describes over 650 hardbound and paperback books which cover virtually every technical and scientific discipline. Special sections in the catalog feature "do-it-yourself" titles and amateur radio publications. Vocational educators and industrial training directors will find textbooks, instructor's guides, and student workbooks in the section entitled "Text and Training Materials for In-Plant and Vocational Education." Copies of the catalog are available free from *Thomas J. Eastwood, Director, Advertising and Public Relations, Howard W. Sams & Co., Inc., Indianapolis IN 46268.*

Direct Positive Photoresist Kit

Vector Electronic Co. Inc., 12460 Gladstone Ave., Sylmar, Calif. has just announced the availability of two new etched circuit kits. According to the manufacturer, these kits are different than other kits now available because they make use of easy-to-make positive artwork, much of which is preprinted and in the kits, plus photo- sensitized copper-clad boards in various sizes. With the materials supplied (which includes everything except water and a photoflood bulb) the user can make sharply defined etched circuits in single or multiple quantities quickly and inexpensively in the laboratory or school without photography. Lead layouts for integrated circuits, transistors, and connector patterns are all ready for transfer to the master circuit mylar



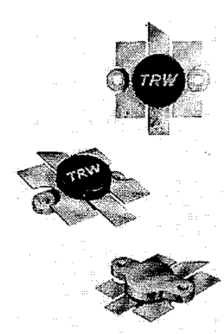
sheet provided. The photo-sensitized copper clad board, which can be used without a darkroom is then exposed to an ultraviolet light source, a photoflood lamp, or bright sunlight to produce a copy of the Mylar circuit image. This image is quickly developed with the chemical provided. The board can then be etched in the furnished etchant that comes in a durable plastic bag which may be shaken inside a plastic box (also furnished) without leakage. Because of the agitated etching, sharply defined circuits can be produced. If a number of the same circuit boards are required, duplicates can be made quickly using the same Mylar master. Kits sell for from $8.95 for the 32X sampler assortment to $24.95 for the professional sized version model 32XA. Kits may be ordered now from the manufacturer, or purchased from the firm's distributors. *Vector Electronic Co., Inc., 12460 Gladstone Ave., Sylmar CA 91342.*

Groundplane Antenna

Varitronics introduces the *Redhead*, a two meter 3.4 dB gain groundplane antenna. This sturdily built, commercial-quality unit is adjustable for low vswr ofer the entire 2 meter band. Both radials and radiator are built of heavy gage aluminum conduit, and the loading coil is well protected by a metal shield which is painted red. The antenna is rated at 500 SSB, 250W CW, AM, FM. See the Varitronics AS-2HG *(Redhead)* at your dealers. Only $18.95.

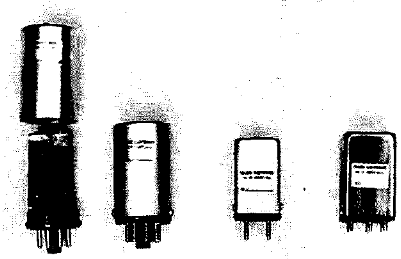
Octave Bandwidth of New 40W on 220-400 MHz

TRW Semiconductor announces a new UHF power transistor offering a state-of-the-art combination of bandwidth, power, and frequency. The family of transistors is termed "J-Zero," because internal matching circuitry reduces input reactance to essentially zero. The new hybrid transistors provide high input resistance with lower input Q. Simple input circuitry with minimum tuning allows combining for output



powers of over 100W across the band. High volume production thus becomes practical for the first time in high-power broadband UHF equipment. Characteristics of TRW type JO-2001 are as follows: 40 watts rf power output from a 24V source; 5 dB gain across 225—400 MHz band; minimum efficiency of 50%. Technical details are available from *TRW Semiconductor Div.,14520 Aviation Blvd., Lawndale CA 90260.*

Series of Highly Stable Oscillators Developed for Two-Way Radio Equipment

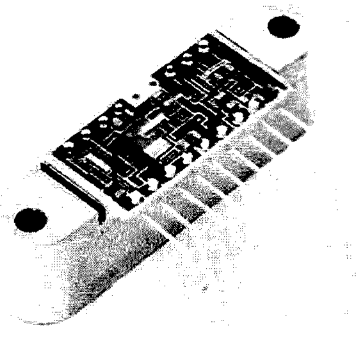


A new line of temperature-compensated oscillators that provide a direct replacement for most crystal ovens used in two-way radio communication equipment was announced by Michael Sigmon, Product Marketing Manager of Sentry Manufacturing Company.

1970 Catalog of ICs and Semiconductors

A complete line of integrated circuits and semiconductors for hybrid microelectronic fabricators is now available from Starnetics. These include the related advanced products of a number of manufacturers. Semi-conductor devices, digital and analog integrated circuits, and memory networks are covered in the offering. All products are stocked in depth and are tested and certified to current military specifications as appropriate. The catalog describing these new products is free and can be obtained by writing *Starnetics, 10639 Riverside Dr., North Hollywood CA 91602.*

Broadband RF Microcircuit



TRW Semiconductors has introduced a new broadband rf microcircuit amplifier, CA800. The amplifier has 5—500 MHz bandwidth with 25 dB gain across the band. It is a universal broadband-gain block in thin-film hybrid IC form for use in 50Ω instrumentation and radio systems. With a 28V supply, 400 mW of CW power output is achieved. *TRW Semiconductor Div., 14520 Aviation Blvd., Lawndale CA 90260.*

Antennas

Cush Craft has just released its new amateur antenna catalog. It includes photographs and complete specifications of more than 50 popular amateur antennas and accessories. To receive your free copy of the catalog write to Cush Craft, 621 Hayward St., Manchester NH 03103.

Clay Gibbs W9SDK
W165 N8615 Dardis Ave.
Menomonee Falls WI 53051

a cheap and easy GUS WATCHER

Trying to insure contacts with Gus (W4BPD) as he roamed the Indian Ocean this past summer (1970), I found a feature lacking in my nearly new SB-301 and SB-401 combo – namely, the inability to use either master oscillator in the receive mode. Only by using a separate receiver could I keep my SB-401 transmitter somewhere in Gus' rather widespread listening area and have a chance of a contact. Two receivers add to the station cost and complexity and often make difficulties for the operator, especially during those late night sessions.

An excellent article by John H. Lehman (WA8MHO) in the January 1970 QST shows how to modify the combo to achieve instant selection of two transceiver frequencies, but this involves rework of the panels which many find abhorrent and provides a function which I didn't need (switching the transceiver frequencies). Also, with only one master oscillator controlling the transmit frequency (that in the SB-401) there would be less chance of operator error.

After studying the problem, it was determined that the switch could be replaced by relays to achieve the same results. However, since we only wanted to switch the tuning arrangement for receiving, one relay in the SB-301 could perform the necessary function.

The circuit shown in Fig. 1 was built using mainly junkbox parts, helped out by finding a suitable 117V ac relay so that no tapping off receiver power was necessary. Keep the coax leads from the relay to the plug and socket in the SB-301 as short as possible to reduce the drive lost in the transceiver position. By proper measurement, it can be built outside the combo and then merely plugged in, letting the one coax cable which runs from the SB-301 to the SB-401 lay under the lids where it is hardly noticeable. However, if one can take the time from operating and DXing to remove the units from their cases, holes can be drilled to permit a straight-through cable run. Use coax cable which is the same as or compatible with that provided in the combo.

A Y-phono connector is plugged into the output socket of the SB-401 master oscillator. The original SB-401 lead plugs into one arm of the Y, the relay lead into the other. Although this adds several inches of coax to the transmitter oscillator output circuit, no loss in drive was detected during operation.

Operation

The SB-401 must be placed in the unlocked position as for any split frequency operation.

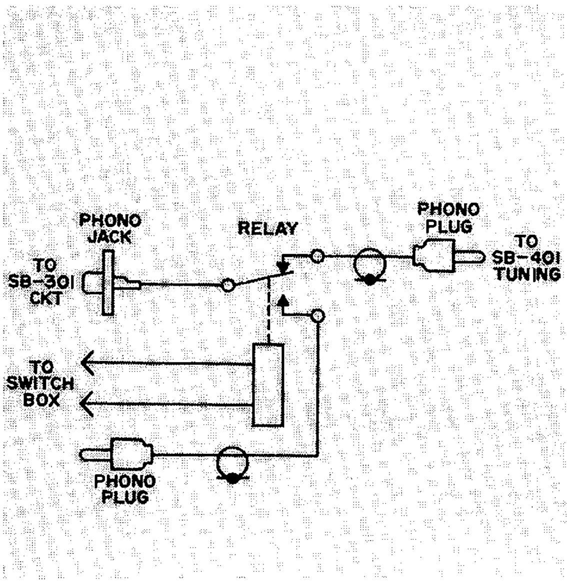


Fig. 1. Schematic of simple modification. Phono plug and socket in the SB-301 mate with existing socket and plug. Phono plug in the SB-401 mates with one arm of Y phono connector. Relay position shown is unenergized and receiver master oscillator is controlling frequency.

Then activating the switch to energize the relay coil (I used a two-position single-pole switch with one side a momentary-on), you can tune in the signals of those who are calling and working Gus; release the switch and you are hearing Gus.

Depending upon components used, coax lengths and previous condition of the combo, there can be some changes in drive during transceive, and an extremely strong signal may feed through faintly during receive but these are considered a minor price to pay in view of the gain in ease of operation during our Gus watching (and working) periods.

All of this for under $8, if you procured everything. A good junkbox would make it free. I bought a small minibox and switch for $2 and installed a neon indicator in the box. The box rests near the SB-301 tuning knob where it is convenient for my left hand to operate as I take a quick listen for my competitors when Gus is listening.

Although this modification may not satisfy the purist, it brings results; I snagged KP6AL and VS5RG (on two bands) during its first week in operation. I hope it proves of assistance to others using this fine combo.

...W9SDK■

73 Reader Service Coupon

Now we don't say that every single reader must buy every last product advertised in 73. We believe that, but we don't say it. The very least every reader can do is to put on a show of interest in the products herein advertised. To make this a simple task, even for the laziest reader (now there is a contest for you!), we have cleverly arranged the advertising index to double as a readers service coupon. All you have to do is tear it out (or photocopy it) and send it in with the appropriate boxes marked. (We have a prize for the most boxes marked . . . a silent prayer of thanks from the publisher). We'll accept postcards, slips of paper, or almost anything else that lists the companies you want to hear from and your address.

No one likes to go into a store without buying something, right? It is the same with these information requests. You will be expected to buy something. Oh, it doesn't have to be a $50,000 antenna system, but it should be something modest . . . a transceiver . . . a linear . . . you know. We'll leave the decision up to you, knowing that we can trust you to do the right thing.

And we are definitely not saying that the use of this service coupon has any curative powers, but we cannot but notice that many readers report remarkable relief from simple backache, headaches, lumbago, and acid indigestion after sending in their coupon. Why take any chances?

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J. H. Nelson

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February 1971

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ARGENTINA	14	7	7	7	7	7	14A	21	21	21	21A	21
AUSTRALIA	21	14	7B	7B	7	7	7	14B	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	21	21
ENGLAND	7	7	7	7	3A	7B	14	21	21	14	7B	7
HAWAII	21	14	7B	7	7	7	7	7B	7A	21	21A	21
INDIA	7	7	7B	7B	7B	7B	14	14	7B	7B	7B	7
JAPAN	14	7B	7B	7	7	7	7	7	7B	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	21	21	21A	21
PHILIPPINES	14	7B	7B	7B	7B	7B	7	7	7B	7B	7B	7B
PUERTO RICO	14	7	7	7	7	3A	14	21	21	21	21	14
SOUTH AFRICA	14	7	7	7	7B	7A	21	21A	21A	21	21	14
U. S. S. R.	7	7	7	3A	7	7B	14	14	14	7B	7B	7
WEST COAST	21	14	7	7	7	7	7	14	21	21	21A	21

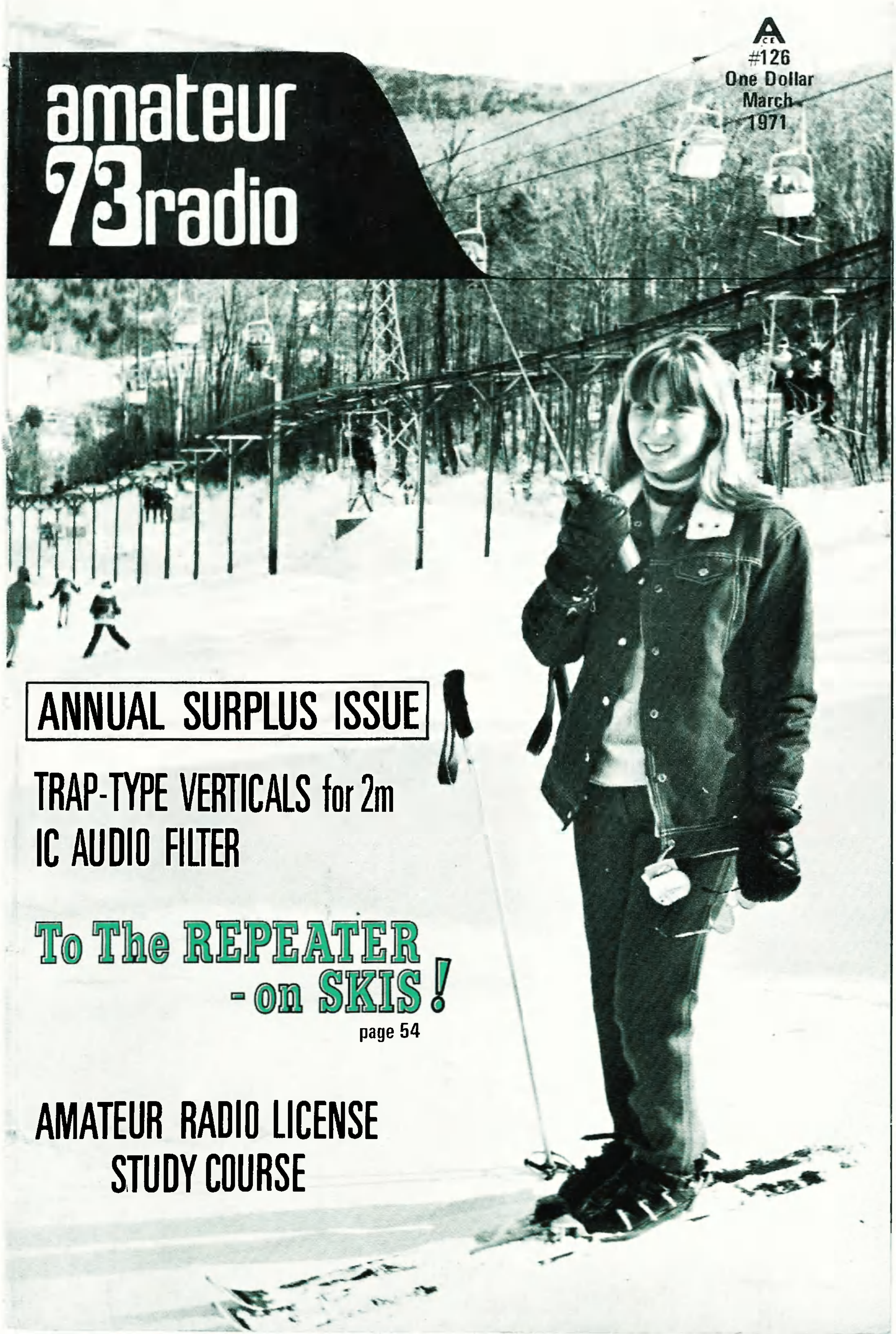
CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7	7	14	21	21
ARGENTINA	14A	14	7	7	7	7	7	14A	21	21	21A	21
AUSTRALIA	21	14	7B	7B	7	7	7	7B	14	14	21	21
CANAL ZONE	21	14	7	7	7	7	7	14A	21	21	21A	21
ENGLAND	7	7	7	3A	3A	7	7B	14	21	14	7B	7
HAWAII	21	14	7B	7	7	7	7	7	7A	21	21A	21
INDIA	7	7	7B	7B	7B	7B	7B	7	7	7B	7B	7B
JAPAN	21	14	7B	7	7	7	7	7	7	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	7B	7B	7B	7B	7	7	7	7B	7B	14
PUERTO RICO	14	7	7	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14	7	7	7	7B	7B	14	21	21A	21	21	14
U. S. S. R.	7B	7	7	3A	7	7B	7B	14	14	7B	7B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	3	3	3	3	3	7	14	21	21
ARGENTINA	21	14	14	7	7	7	7	14	21	21	21	21
AUSTRALIA	21	21	14	7B	7	7	7	7	7	14	21	21
CANAL ZONE	21	14	7	7	7	7	7	14	21	21	21A	21
ENGLAND	7B	7	7	3A	3A	7	7	7B	14	14	7B	7B
HAWAII	21	21	14	7	7	7	7	7	7A	21	21A	21A
INDIA	7B	14	7B	7B	7B	7B	7B	7	7	7	7B	7B
JAPAN	21	14	7B	7	7	7	7	7	7	7	7B	14
MEXICO	21	14	7	7	7	7	7	7A	21	21	21A	21A
PHILIPPINES	21	14	7A	7B	7B	7	7	7	7	7B	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	21	21	21A	21
SOUTH AFRICA	14	7	7	7	7B	7B	7B	14	21	21	21	14
U. S. S. R.	7B	7	7	3A	7	7B	7B	7	7	7B	7B	7B
EAST COAST	21	14	7	7	7	7	7	14	21	21	21A	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.



amateur 73 radio

#126
One Dollar
March 1971

ANNUAL SURPLUS ISSUE

TRAP-TYPE VERTICALS for 2m

IC AUDIO FILTER

To The REPEATER - on SKIS!
page 54

AMATEUR RADIO LICENSE STUDY COURSE

Issue 126

Amateur Radio 73

March 1971

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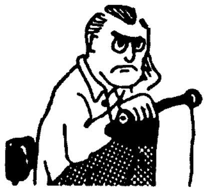


...de W2NSD/1

NEVER SAY DIE

SAROC 1971

These being days of impoverishment, I had not intended to make the scene at Vegas. At the last minute Ken put on the pressure and, with the hopes of perhaps selling a page or two of ads to help balance the books, I hopped on down there.

Just after taking off from Boston I had a short contact with W1TNO through the W1ALE repeater in Concord, N.H. No answers at Schenectady . . . some short contacts in western New York . . . Cleveland was kept busy with long-winded nonlistening talkers . . . ditto Detroit . . . contacts in Chicago . . . no one around in Urbana . . . and so it went. Omaha was not open to breakers. About ten minutes out of Vegas I picked up their repeater and talked with the gang the rest of the way in, while waiting for baggage, and during the limousine ride to the hotel. One mobile pulled up alongside, waved, and then broke in to say hello.

It was colder in Vegas (15°) than in New Hampshire so I grabbed my camera and went across the street (watching out for any possible ARRL-driven cars) and took pictures of the ice-encrusted fountains at Caeser's Palace. Art Housholder W9TRG, arriving on a Frontier Airlines plane, came through the repeater at this time and I talked with him as he flew over Lake Mead and later while he was waiting for his baggage at and every mobile within 100 miles of town. My last contact was from the airport as I went to get on the plane and I said goodbye to Ken, who was just that minute getting out of bed back at the hotel. TWA shut me up from there until I landed in Boston. I have this black curse to put on TWA: May the board of directors eat one meal a week in the tourist section of their planes. That'll hold 'em.

FM/Airborne

Yes, I use my little two meter FM hand transceiver while I'm a passenger on the airlines! It works out beautifully, too. About the only serious problem I have with it is trying to get a word in edgewise on the repeaters I fly over. All too few of the fellows talking over repeaters ever give even one second for a passing-through breaker.

On the way to Saroc I tried to get through a number of repeaters, but just couldn't break the big signals with my hand transceiver. Oh, there were several that I did get into and it was fun to talk for the few minutes I was within range.

How about the plane, you ask? Many of the FM'ers who have hand units have tested them to make sure that no interference is caused to the plane radio or instruments and none has occurred. Considering the use of FM, the frequency and the low power involved, I would not expect to find any interference. Most of the FM'ers

THE WORLD OF FM

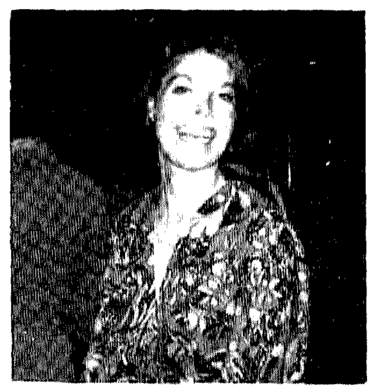
Editorial by Ken Sessions K6MVH

THE FM SCENE

SAROC was great fun this year. The Flamingo Hotel provided excellent accommodations and Las Vegas provided the atmosphere. I didn't hear a single complaint from so much as even one ham this time.

Times are a'changin', too. A few years ago, gamblers and hotel officials got uptight at the sight of individuals carrying hand-held transceivers through the casinos. But with literally hundreds of 2m FM units protruding from the pockets of so many hams this year, the hotel people apparently grew accustomed to it. No one reported any problems at all – except for the fact that the hotel security people reportedly complained that the hams had newer and better equipment

Dr. Phil Dater, representing the New Mexico repeater chain, gave a slide presentation showing repeater progress in the midwest.



Pretty Linda Mueller, wife of WB6IGZ, tended bar in Room 1031A, a spur-of-the-moment hospitality suite.

The lovely Sharon La Traille, of Varitronics, Incorporated, demonstrated 2m transceivers, amplifiers, and antennas.

FEATURES

On The Cover:

Lin Green talks home via two meters while skiing on Mt. Snow in Vermont, checking on daughter Sage, being minded by Ken. The 110-mile path is via K1ZJH repeater about 60 miles away. (Where's Wayne, you say? Who do you think took the picture?)

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the airport . . . I was just walking around taking pictures all the while.

SAROC was an FM convention this year. The ARRL Forum pulled about a dozen while the FM Forum next door was jammed with hundreds. Ken Sessions organized the FM program and it certainly was the hit of the convention. Most of the exhibitors were FM oriented . . . Regency was there en masse . . . Varitronics displayed their mobile IC2F, their hand unit, and lovely Sharon LaTraille (you saw her in the "Ham's Wide World") . . . Drake had their sideband gear there, but the attention was on their Marker Luxury FM rig and the brand new TR-22 walkie-talkie unit . . . Walt Henry proudly displayed his Tempo FM rig . . . Galaxy was there with their FM-210 . . . Standard displayed a new transceiver and a mini-repeater. Lou Tristao had a tower that he feels FM'ers will like . . . Swan was showing their new FM rig from Japan . . . Ross & White showed their line of tone encoders and decoders . . . Sentry took orders for a lot of crystals from their interesting booth . . . and so it went.

A few non-FM manufacturers were present too . . . Dick Ehrhorn was showing his new all-band linear amplifier . . . Collins was there, but with nothing new for the amateurs and no FM plans whatever in the foreseeable future . . . Carl Mosley was there . . . Robot had a nice demonstration of slow-scan television. Spectronics brought a bunch of FM Motorola hand transceiver modules and the building crowd cleaned him out . . . ComSpec had its new gain vertical 2m antenna on display as well as their new 2 meter 50W amplifier . . . the Pierce-Simpson FM unit made its first appearance at SAROC.

My HT-220 hand unit was with me day and night and I have to admit to having a lot of fun. I kept in constant communication with Ken, the FM hospitality suite, dozens of friends, the convention, the exhibits, the talks, ask the plane captain for permission to use their rig while flying and, though permission can be refused on the basis of a regulation against using receivers in a plane, usually there is no hitch.

Sad to say, TWA has been one of the least cooperative with amateurs. Alas, I've been riding with TWA since they were Transcontinental Western Airlines, over 40 years ago, but I will choose alternative travel in the future where possible since I do enjoy operating while traveling. It wouldn't hurt them any to be nice . . . there is a lot of competition . . . and a growing number of amateurs with hand transceivers. The new little Drake unit (1½ watts) would be ideal for this!

Perhaps I should be in more awe of the complicated electronics in these planes, but my experience as a pilot, my tenure with Airborne Instruments Laboratories, and other background has lessened the mystery. Add to that several trips with no interference reported, even with a 5W unit, and similar reports from a dozen or other amateurs.

So look fellows, when you are talking through a repeater about something of earth-shaking importance, like how many 6SN7s you have left from the old days, won't you be nice enough to at least take one breath between transmissions so I can break in for a minute or so and say hello as I pass over on some other airline than TWA? You can't imagine how frustrating it is to hear you down there talking without being able to ever break you!

New Repeater Bulletin

Mike WA8UGT has announced that he is planning on starting a repeater bulletin later this year. I am sure that all of us who remember the fine FM Journal that Mike and Ken Sessions published; will be pulling for him to make it this time. With all but one amateur magazine reported to be in the red this is a particularly difficult than they themselves had been issued. *C'est la vie!*

Some nice surprises were in store for convention-goers. Mr. Everett Henry, FCC officer in charge of amateur and CB policy-making, showed up and agreed to answer questions from FM'ers. He drew a bigger crowd in the FM room than any other speaker on any other subject in any other quarter. He was peppered with questions about repeater rulemaking, unofficial sanctions, and such matters, and managed to sidestep all major issues with the adeptness of a politican.

The whole staff of Regency Electronics showed up. They were kept busy demonstrating the company's growing line of equip.

Walt Henry, of Henry Radio, showed his company's new high-performance, low-cost Tempo FM transceiver, which was itself a smash success at the convention.

Mr. Henry's evasiveness was understandable, in view of the fact that the FCC does not plan to get deeply *involved with repeater legislation until* after the "phone band expansion" issue is settled. The notorious docket (18803) as well as my own petition (RM-1725) are both stacked neatly on the desk of FCC's Bill Grenfell, who will get going on them some time before midyear.

SAROC's display area looked pretty much "FM," too, with manufacturers proudly showing their latest FM transceivers, rf amplifiers, and other related hardware. Art Householder showed slides of Spectronics to a packed house. The fact that he did it in the "hospitality suite" contributed to its popularity; the room was stocked with free beverages.

For me, SAROC was a stepping stone to a tropical vacation. When the convention was over, I flew to Los Angeles for a week in the sun and smog. Thanks to the hospitality of my California friends, the week was not as expensive as it could have been.

But I'm glad the week ended when it did. My California friends all know that I flip over Mexican food, and that Mexican food is just not available in New England. So each of my contacts in California went overboard to serve

cont. on page 6

VK HAMS HELP "LA BALSA" MAKE LANDFALL

by Alan Shawsmith

In an effort to prove a 1000 year old theory, that the early peoples of South America could have drifted to Australia, by making use of the Equatorial currents and winds, four courageous young men, one of them being a ham, HC9EBP, left Ecuador on May 29 1970, on a 45 ft raft made basically of seven large balsa logs. Appropriately, they named it La Balsa. Filled with the challenge of adventure, they hoisted a square mainsail and with hopeful hearts, turned their primitive ship and faces westward. After a drift of more than 8500 miles across the Pacific, they arrived safely at a small boat harbor named Mooloolaba, 80 miles north of Brisbane.

This incredible sea journey, in a nonpowered craft, must rank as one of the greatest ever by modern man. Others before this have set out from the west coast of South America, but none have come so far or been so long at sea (161 days) in one single hop. They survived the tropical heat, sickness, many severe storms in which all but one were washed overboard at one time or another, including the cat Minette, and by a mixture of skill and good fortune, managed to avoid the numerous coral reefs and shoals along the way.

IARU REGAINS OBSERVER STATUS

The International Amateur Radio Union, an organization of national amateur radio societies run by the ARRL, was removed from the list of organizations permitted to send observers to the International Telecommunications Union meetings by an action of the ITU Administrative Council in 1966.

IARU representatives have never been permitted to participate as other than silent observers at the ITU conferences. Even amateurs sent by their national societies have been unable to be accredited by their own country delegations (except for the U.S.) with the result that radio amateurs have had virtually no say whatever on the frequency allocations set up for them. As a result, amateur frequencies have been constantly eroding at these conferences. The services best represented have been able to hold or gain in frequencies and those least represented have lost the most.

Now the ITU Administrative Council has reconsidered its decision and again will permit the IARU to send observers to the ITU conferences. While this is better than nothing, the real action will come when amateurs are permitted to join their country delegations.

TURKISH HAM NEEDS U.S. SPONSOR

Selim Canbeken TA2SC, 19, would like very much to come to the U.S. and learn about electronics. There just isn't any good education in this field available in Turkey and Selim knows what he wants.

Amateur radio has not been legal in Turkey for citizens since 1937 so the 150 or so active amateurs have operated quietly and in fear. Radio equipment is almost nonexistent and generally has to be built from what can be scrounged. There are no radio stores or manufacturers as in the U.S. Even so Selim was able to build a sideband transceiver, a linear amplifier and even a slow scan televsion flying spot scanner!

On April 28, 1970 the police came and confiscated everything . . . antennas, test equipment, a prewar National 100XA receiver, logs, QSL cards, parts, transceiver, linear . . . everything. This was a cruel turn of events for this avid amateur.

Selim writes, "Now I am a Tone Maister for the famous Turkish singer Zeki Getin. We are working every night at night clubs. This life isn't good for me. Last year I finished my school. I want to go to the U.S.A. for an electronic education. I can work

Approaching Australia, they faced their greatest danger, the treacherous thousand-mile-long Barrier Reef. It was at this point in their voyage that the VK hams began to play a vital part in this Norse-like saga of the sea. Amateur radio operators in Queensland and New South Wales were first alerted by Gus, ZM1RO, in New Zealand, that an unidentified vessel, possibly *La Balsa*, was approaching Barrier Reef. XE1EEI, in Mexico, who had attempted to follow and plot the course of the raft, had passed the message across Oceania that, according to calculations, the raft should soon be within radio range of the east coast of Australia.

During the period the raft was in mid-Pacific, the 100W transmitter it carried became inoperative, due to a faulty microphone – all that *La Balsa* could send was a series of clicks (not Morse). This raised the problem of positive identification and caused many who were listening to proclaim the signals as a hoax. The first ham to pick up these faint clicking signals, on 28 October 1970, was Sid Molan, AX2SG. Others then reported them. The unidentified vessel was asked to send a certain number of clicks, if it was, in fact, the *La Balsa* raft. This it did and regular daily schedules were then maintained at 0400 GMT on 14100 MHz.

Many still refused to believe the signals were genuine. They insisted no raft could remain afloat for this length of time, especially as other ships in the area had reported no sightings. So the mystery deepened as the still unidentified boat approached the East Coast of Australia. At first it appeared to be on a collision course with the Swain reefs, one of the most treacherous areas of the Coral Sea. However, a wind change enabled the raft to bypass this dangerous area. Keith Schleicher, AX4KS, and Les Bell, AX4LZ, were now both receiving the clicking sounds very clearly. With Sid acting as controller, an intense daily vigilance was maintained. A varying code of clicks was devised and in this way much information was exhanged between the raft and the three hams. For example; Sid would request them to send four clicks if all four men were fit and well. A group of two or three clicks would indicate the number of knots drifted during each 24 hours. Their position in Lat. and Long., the state of the weather, the barometric pressure, and much other vital information was transmitted in this manner.

The raft was now in a busy Australian sea lane and all ships alerted but still no report came through. Excitement reached fever pitch. News papers ran headlines, "LA BALSA OR HOAX? – INCREDIBLE JOURNEY" – and so on. On the morning of November 4th the raft indicated it may soon need some assistance. A strong on-shore wind was carrying it close to the coast of Queensland. A plane and boats were dispatched to search in the given area, but by darkness ho sighting had been made and the affair remained as mysterious as ever. The skeptics still insisted it was nothing more than an elaborate hoax. Then, at 2300 GMT on the next day a searching plane radioed it had located La Balsa twelve miles off the Australian coast. The frequency came to life as many hams who had been listening quietly for days now briefly broke with congratulations. Air and sea emergency rescue services directed a boat to the scene and the raft was taken in tow to the nearest harbor, some 20 miles away. Capt. Alsar, HC9EBP, and his crew, triumphant and smiling, were taken ashore to a thunderous Australian welcome.

Without the VK hams' timely vigilance and direction – and most of all, their insistence that *La Balsa* - was real – it is possible that the raft could have found itself in difficulties, handicapped as it was with no phone or CW transmission, and no one would have known. It might have been wrecked on Great Barrier Reef or struck by a passing ship or crashed in bad weather on some inhospitable part of the coastline.

At the official welcome on Australian soil soon after *La Balsa* crew had landed, Captain Alsar proffered his thanks and gratitude to all the hams who had monitored his transmissions right across Oceania. They were Raphael XE1EEI, Joe HC2OM, Gus ZM1RO, Sid AX2SG, Keith AX4KS, Les AX4LZ, and many others. Well done, chaps!!

RM PRICES STYMIE PROSPECTIVE BUYERS

W5PGG was interested in getting a copy of the RM's on file with the FCC listed on page one of our October issue. He wrote to the FCC and asked for copies of the RM's. No dice. They suggested he get in touch with a company that specializes in that service. Orville wrote to them, giving his list, and got back a quote for the service of $98.46 for the copies of the nine RMs. This cooled him.

for enough money to pay my way while I'm in school. Perhaps I can stay for one year and live with an American family, then I can select a good way for my future. Perhaps I can select to be an American citizen. I have my high school diploma so I can join a school to be an electronic engineer or an electronic technician. This is my ideal for my future."

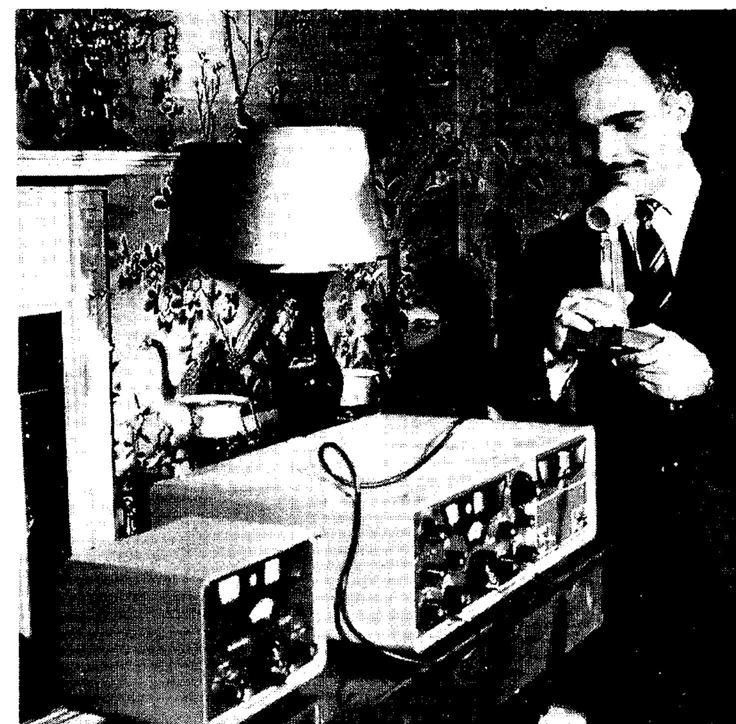
Are there any ham families near a good school who might have room for this amazing youngster? Write to this fine boy . . . Selim Canbeken, P.O. Box 106, Adapazan, Turkey.

HIS MAJESTY OPERATES PORTABLE IN LONDON!

Uses Ham Radio to Relax While Recuperating from Heart Attack

King Hussein was hospitalized in London for about three weeks, possibly recovering from a mild heart attack brought on by his extended visits to a number of countries during the preceding few weeks. Within a few days he was on the air using a Drake station operating primarily on 15 meters with the call of G5ATM, keeping his schedule with WA3HUP and other friends. While in the U.S. the king visited New York and Washington, staying at Blair House. A number of amateurs that had contacted JY1 visited with him during his stay in Washington. Hallicrafters presented HM with an SR2000 transceiver during his Washington visit. Hopefully we will be hearing this unit from Jordan one of these days.

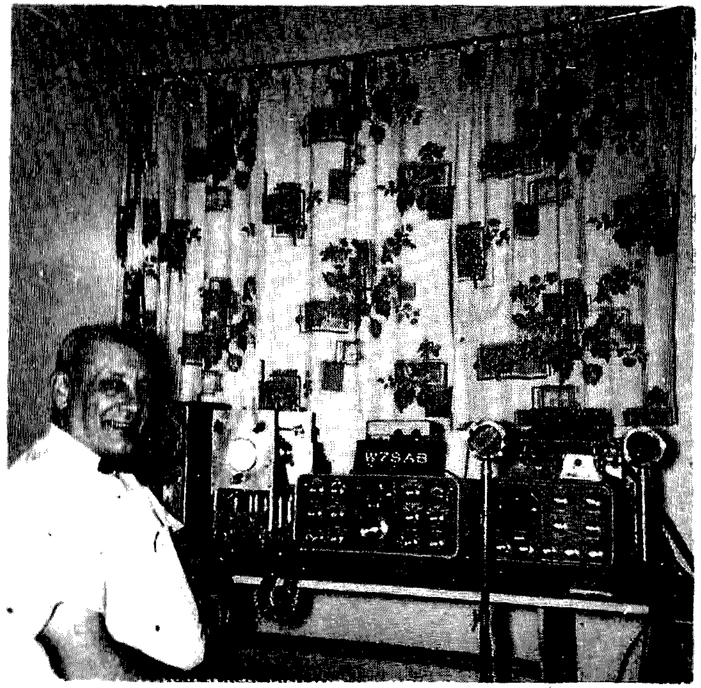
Many interested amateurs had an opportunity to see the king at length during a one hour interview on the David Frost show. HM acquitted himself well on this show and those that watched it were able to learn a good deal about the Mideast problems.



WESTERNERS ACTIVE IN SLOW-SCAN TV

by W7SAB

The Western SSTV net has grown to quite a few members (principally on the west coast and middle west areas, though check-ins continue over the whole USA and anyone wishing to check in is certainly welcome). Technical information and experience with various equipments are available and more especially availability of hard-to-get parts for those unable to locate them. New stations are always welcome and in fact such stations as KH6BAS in Hawaii have been practically developed with information over the air from W7SAB and K7YZZ, who have spent many hours in getting him set up and operating. Also stations KL7FHN and KL7DRZ in Alaska have received assistance and hard-to-get parts from the group. I1LCF in Bologna, Italy has drawn heavy support and parts in getting his station in operation. ZS6ASR and ZS6PP have also received assistance. Likewise for ZL1DW, ZL1AOY, and ZL1NH (who has actually visited the group). Some contacts have also been made with UW6LC.



Normally the net is conducted by W7SAB with W7FEN, K7YZZ, W7VEW, W7ABW, WA7MOV, K6STI, K6IV, WA7LQO, WB6OMF acting alternate net control For some time the net has been formalized as the Western SSTV Net and on 5 May the 40 meter division of the Western SSTV Net was opened on 7220 at 9:30 local time. Some attempts have been made to interest our Canadian friends in SSTV and in fact a demonstration has been given recently at the University of British Columbia with 55 Canadian amateurs present in which slides, equipment, lecture and actual live demonstration was conducted. Demonstrations and lectures have been given throughout the NW at various radio clubs and K7YZZ has had several articles presented in 73 Magazine, and W7FEN and W7ABW have an article in June 1970 QST.

Early developments in SSTV have been thoroughly covered by our several amateur publications and a complete bibliography is quite comprehensive and of great help in getting started in SSTV. As much of the equipment must be designed and built by interested parties I would consider this activity a great incentive for advancing amateurs in the state of the art and general performance.

The above information about covers the activities and organization of the Western Slow Scan Television Net and I hope this will be of some help to you. I will again list the times and frequencies of the nets for your information.

3845 kHz 9:00 p.m. (PST) nightly
7220 kHz 9:30 p.m. (PST) nightly

HAM POPULATION EROSION

DX NEWS

VE COUNTRIES BANNED

By special edict dated 14 October, 1970, the Department of Communications has requested that all Canadian Amateurs be alerted to new regulations covering communications with various foreign countries. As a result the fifteen countries are now on the banned list under the authority of: ITU, annex 2, to operational bulletin No. 55, dated 13 July, 1970.

A list of the forbidden countries is as follows:

Burundi	9U5
Cambodia	XU
Cyprus	ZC4
Gabon	TR8
Greece	SV
Indonisia	8F
Iraq	YI
Jordon	JY
Laos	XW8
Libya	5A
Pakastan	AP
S. Yemen	4W1
Syria	YK
Turkey	TA/TC
Vietnam	3W8

INDIAN NEWS

VU2GV

New Delhi. We are happy to advise you that we have been successful in getting a favourable response from the Government to our proposals for utilising the radio amateur network for handling traffic in emergencies. We are also hopeful that some arrangements can be worked out for establishing an emergency net for simulated emergency tests by the authorities. This will give adequate opportunity for both sides to get acquainted with emergency procedures.

In order to enable this to be properly organised it is proposed to

TOKELAUS

The ZM7-Tokelaud effort looked ready to roll, then it foundered. Initially VE7HE and VE8RA had planned to stay at the home of the Catholic priest on the Tokelaus. However, with Pope Paul VI visiting Pago Pago, the padre locked up and took off to serve on the reception committee. Then the captain of the vessel they were to use began to worry about the typhoon season and the rhinoceros beetle and soon both the housing and the transportation had evaporated.

Apparently there is no docking space at these islands and ships have to lay offshore. The rhinoceros beetle infests the palms and ships have to get beyond three miles at night when the beetle is prowling about in order to avoid becoming a host for the beetle. So with the typhoon season around the corner and the beetle problem, the vessel was not available. It seems that one must have definite accommodations to be allowed on the Tokelaus and the captain of the vessel was not for laying off the island for any length of time.

So this effort did not jell just about the time when everything seemed ready to go. VE7HE and VE8RA spent the week in Western Samoa signing 5W1AG and 5W1AR. They had a good signal and their Tokelaus efforts, which came close to being accomplished, certainly would have gone well.

NIUE

ZK2AG, Trevor, reported as active. Was at 14210kc at 0415Z – with an HW-32 and using a dipole 15 feet up in a palm. Home call said to be ZM3TV. ZM4NH to handle QSLs. Mail service intermittent from the island . . . about once monthly. Said

ANNOUNCEMENTS

Columbus, Georgia Hamfest

The annual Columbus, Georgia hamfest will be held on March 21, 1971 at the Fine Arts Building behind the Municipal Auditorium at the Fairgrounds. For information, write John Laney, K4VGI, 1905 Iris Drive, Columbus, Georgia 31906.

CONNECTICUT QSO PARTY
April 3–5, 1971

The Candlewood Amateur Radio Assn. invites hams throughout the world to take part in The 8th Connecticut QSO Party. Rules: 1) The contest period is from 2300 GMT April 3 to 0400 April 5. Each station may be worked once on each band and mode. The general call is "CQ CONN" on cw and "CQ CONN QSO PARTY" on phone. 2) Conn stations send QSO number, RS(T) and county. All others send QSO number, RS(T) and ARRL section or country. 3) Score one point per QSO. Out-of-state stations multiply total contacts times the number of countries worked (maximum of 8). Conn stations multiply contacts times the number of ARRL sections and countries worked. 4) Certificates will be sent to the high scorer (6 or more contacts) on each ARRL section and country, also the two highest scorers in each Conn. county. Novice certificates will also be awarded. 5) Suggested frequencies are 3540 3925 7040 7275 14040 14300 21050 21300 28040 28880 kHz. Novices try 3740 7175 and 21125 kHz. 6) Logs must show dates, times in GMT, band, mode, QSO numbers, RS(T) and QTH. Send all logs before May 20 to the Conn QSO Party, c/o Tom O'Hara, W1DDJ, 7 West Wooster St., Danbury, Conn. 06810. Include an SASE for results.

OOTC QSO PARTY

The Old Old Timers' Club will hold its 1971 QSO party April 2nd through April 5th starting and ending at 2300 GMT. Suggested frequencies for locating the gang are plus or minus the following: 3520, 3530, 3820, 3830, 7020, 7030, 7240, 7260, 14279, 14290, 21021, 21030, 21270 and 21280. Participants should avoid any possible interference on any of these frequencies which may be used for net operations.

.The FCC figures show that the total number of licensed amateurs dropped 683 during 1970. That isn't much of a drop, assuredly, but when compared with the 40,000 gain that we should have had, it is not encouraging.

During the month of December we gained 29 Extra class licensees and 102 Advanced class licensees. All other classes dropped. Somehow 29 Extras out of 264,000 has a message in it somewhere for the incentive licensing enthusiasts who still believe that punishment is better than rewards for getting results.

NO NEWS IS BAD NEWS • MAIL YOUR STORIES, PIX, AND NEWS TO 73 NOW.

ARRL GREAT LAKES DIVISION CONVENTION

MUSKEGON COMMUNITY COLLEGE
QUARTERLINE RD,
MUSKEGON, MICHIGAN.
LARGE SWAP & SHOP, MEETINGS FOR ALL MARS PROGRAMS, VHF REPEATER PROGRAM, NET & TRAFFIC MEETINGS, RTTY FORUM, HAM TV, RACES-CD, MIDCARS, QWCA MEETING, AND MANY MORE. COMPLETE LUNCHEON FACILITIES, PARKING FOR OVER ONE THOUSAND CARS, EASY ACCESS VIA INTERSTATE 196 & US-31 TO MUSKEGON, JUNCTION OF US-31 & MICH. 46. COMPLETE NEW AND COMFORTABLE FACILITIES AT THE NEW MODERN COLLEGE. MAIL ADDRESS: *P.O. BOX 691, MUSKEGON MI 49440*

NEW PRODUCTS
Callbook Supplement

The Radio Amateur Callbook Magazine has come up with a new and valuable service . . . a quarterly supplement. Now, instead of having to buy a complete new Callbook every quarter if you want to be sure and have the latest addresses, you can update your most recent book with this supplement.

The supplement even has some advantages over the regular Callbook listings in that it lists all call letter changes when amateurs move from one call area to another and also lists all deceased amateurs as such. This is valuable information that we've missed in the past.

The Spring 1971 Supplement will sell for $3.50. That compares favorably with the $8.95 for the U.S. book and $6.95 for the DX edition. The Supplement covers U.S. listings and U.S. possessions only.

form an All India net at 2030 hrs. IST daily on 14130 kHz. The net will commence operation with VU2KV as the Net Control but we require volunteers to act as alternatives for net control.

We are expecting some teletype machines to be released at reasonable prices. Though these are not in a working condition they can be cannibalised and a few made workable. We would like to know who all would be interested in getting these and get on RTTY. RTTY would greatly facilitate traffic handling in emergencies and would make this easy and fast.

he would be on nightly when possible but on Saturdays especially from 0200–0400Z in the 14220–14240kc area. Wally, SK2AF, presently on leave.

ST. BRANDONS

Alex, 3B8DA, who operated as 3B7DA from St. Brandons, advises that his gear,,,both the transmitter and receiver . . . suffered damage on his return to Mauritius from St. Brandons. This was gear donated by the Southern California DX Club and Alex is looking for some assistance to get the gear operating again. His present plans call for him to go to Rodriguez in 1971, possibly signing 3B9DA. Home address is 39 Brown Sequard Ave, Vacoas, Mauritius. The damage was done by sea water dousing the gear. Alex also interested in stamp collecting.

CHAGOS

VQ9SM said to be on pretty much of a regular schedule. 14233kc at 0200Z daily; 14030kc at 1400Z. Sometimes this rotation is reversed and he may appear at 14233kc at 1400Z. Reported to be crystal controlled at these frequencies. QSLs go to JAØCUV/1 . . . Tack Kumagai, Post Office Box 22, Mitaka, Tokyo.

DX FOOTNOTES

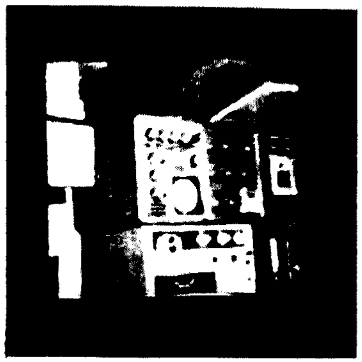
Rio de Oro. Justo EA9EJ is the only active station in this rare spot. Four other amateurs are presently in the country, but no licenses for operation are being issued by the Spanish authorities. Only Justo may operate his rig and no one else. Justo is usually active on Fridays and Saturdays on 14130 from 0600 GMT.

East Pakistan ON5DO/AP2, 14206, over there on hurricane relief mission. QSL to ON5KL.
Sikkim AC3PT, Namu, 1230Z, 14292, coming back to looong calls.
Arabic Net, 7Z3AB net control, Fridays 0830Z 21300, 0600Z 14200. You can work nice ones such as YK1AA, SU1MA, ST2SA, MP4BHH, 7X2's, 9K2's, etc.
Caribbean Net, 3804 @ 1000–1100Z.
Canton Island K6AZB/KB6 Norm 0200–0500Z 14325.
Marcus Island, 2200Z 28550, Dick, QSL JA1BA.
Oman MP4MBB 1230Z 14235, John, QSL G3LQP.
Trucian Oman MP4TDK 1530Z 14078, Dave, QSL RSGB.
Sudan ST5AD 0730Z 14247, Alban.
Pitcairn Island VR6TC 0600–0700 14185 Sunday, 0500Z 14230 Wednesday, Tom.
Rodrigues Island 3B9BZ Bert 1400Z 14200, QSL 3B8AD.
Laccadives VU5KV, QSL Box 3031, New Delhi with 5 IRC's.
Vietnam XV5HH 1230Z 14169, QSL W9JT.

LETTERS

Gray Matter

These photographs refute a statement which Wayne made in the January issue in the discussion of the EKY Video SSTV gear. Wayne stated that the SSTV pictures are composed of blacks and whites with no grade shades. The SSTV standards presently in use provide for a continuous gray scale between black and white as the photographs certainly show. To be frank, the lack of gray values in the gear that Wayne was observing was



probably a function of improper construction or adjustment in that particular piece of gear. Improper setup of the video discriminator will decrease the dynamic range of the monitor and result in an overly contrasty picture. SSTV pictures of normal well-lit scenes, whether televised with a vidicon camera or flying spot scanner, have excellent gray-scale rendition and I am sorry that EKY's gear gave the impression that this wasn't so. There are enough constraints required with the SSTV system that I tend to be perhaps overly sensitive to comments that impart still more patches worth? Is a human life expensive enough?

At about 0330 EST on Christmas Day, 1970, I was driving home from a party at a friend's house in Miami. As I pulled up at a light on a deserted street, I saw that the car on my right was smashed in in the front, the door was open, and a person was sitting on the seat with a smashed face, losing blood, and in shock. At this time of the morning, when very few persons are awake to answer a radio call, the Miami autopatch enabled me to have the police and an ambulance on the scene within three minutes.

The ability to contact the police, while not necessarily instrumental in saving this person's life, has undoubtedly been so in the past, and will undoubtedly be so again in the future.

To the opponents of FM and the repeaters, I would like to ask another question. How would you feel if you became involved in an accident on a deserted road late one night? Would you still be so opposed to that conglomeration of black boxes, antennas, and telephone lines if the ham who happened along procured an ambulance for you? You know, it's happened in the past, and it could happen again.

Amateur radio is very much h a hobby of public service. If a repeater and an autopatch provide this particular service only once in five years, what is the price of a human life?

Jeffrey R. Harrow WA4RLG

FM Correction

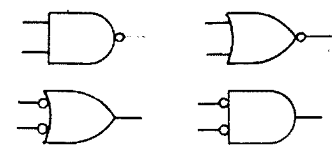
We have read your article regarding the Regency HR-2 2 meter FM transceiver in the December issue with great interest. We were disappointed to see that the chart contained in the article had one significant error and one significant omission with regard to our unit.

First, our SR-C806MA sells for $335.00 not $349.00. It also comes complete with 4 channels, not just 146.94 as indicated. I am sure these clarified to avoid misleading your readers.

Virtually *all* DTL IC's available from any source are in the so-called "930" family which requires a supply of +5V ±10% rather than the +4V mentioned in the article.

Your definition of an inverter talks about "+ and - logic." In fact, an inverter has nothing to do with positive and negative logic or positive and negative voltage. An inverter merely inverts the logic signal put into it: a *0* becomes a *1* and a *1* becomes a *0*.

Figure 4 has two logic symbols called 2-input *nand* gates. The one labeled "most common form" is correct, but the other is one representation of a 2-input *nor* gate. The correct symbology is shown below:



NAND NOR

The "typical buffer with gated input" in Fig. 5 is simply two *and* gates with their inputs and outputs in parallel to increase the drive capability. This is possible with RTL, but is more complicated with DTL and TTL.

The "flip-flop" in Fig. 5 is not a flip-flop unless *nand* gates are substituted for the *and* gates shown.

The paragraph which says that you can make a 3-input gate from a 4-input gate by grounding one of the inputs is true for the *nor* gates used in RTL but not for the *nand* gates used in DTL and TTL.

The existence of a clock input has nothing whatosever to do with a flip-flop being RS or JK. An RS flip-flop is defined by its response to the R and S inputs, as shown below:

R	S	Q
0	*0*	no change
0	*1*	*0*
1	*0*	*1*
1	*1*	unknown

that I ask my friends to write a short letter indicating what we ham experimenters have accomplished and how my activity has influenced or helped their progress. I'm sure anything that could be truthfully said will aid the city officials in understanding more about ham radio and its benefits.

If your local newspapers have written up ham activities or accomplishments, include the clippings with your letter. Be sure to include any specific association and activity with me.

Please address your letter to:

San Jose City Council
801 N. First Street
San Jose CA

Letters should be mailed as soon as possible.

Mike Staal K6MYC

HELP!

I recently came into some good fortune by being handed three wide band amplifiers, Instruments for Industry Model 500A, without tech data. Since I am a Novice and very limited in my electronic background I would like to know how and where I might use these beautiful pieces of electronic gear. And if it's not asking too much, how about where I might pick up a schematic and some additional tech data, as the corporation is now defunct.

Ted Onyshczak WN30IP
302 Red River Ave.
W.S.M.R., NM 88002

Thumbs Down

I am not renewing my subscription for the following reasons:

1. I don't like FM, much less repeaters which monopolize frequencies. (Maybe 10 years of Uncle Sam with FM & repeaters gave me this negative attitude.)

2. The condoning of amateur radio to support alien causes.

3. Lack of articles etc. for an old brasspounder like myself.

4. The constant lambasting of

I thought you were exceptionally kind to the ARRL in your writeup of the Boston Convention. Personally, I thought it (except for 73's room, of course) a waste of time. I left after three hours of the first day and enjoyed some flying out of Hanscom AFB.

Bob Lauzon WB2NSD
Drawer G
Pittsford NY 14534

CW/Phone Split

The continuous battle between the phone and CW boys (I am of the latter group) could be solved (hopefully) by exactly splitting all ham bands – half for phone, half for CW. Those who can't hack the code could flap their lips all day at a mike, and those of us who can't talk could wear out our fingers to our hearts' content.

Of course, on the CW half, code proficiency would remain the criterion as determining just how much of a band a feller could use. But what would the phone boys do? See who could talk the fastest?

William S. Cronan III WA6NPB
9056 Willowgrove Ave.
Santee CA 92071

50/50 split seems a little unfair considering phone users outnumber CW men by more than 20 to 1.

. . .Ken

More FM

Just a note to let you know I appreciate your magazine very much. I don't always agree but we're not all perfect. Too bad the "boys" in Connecticut don't know when to leave well enough alone, e.g. Incentive Licensing, Repeater Rules. How about some more FM articles. I'm new in the FM game. Already have Ken's great book.

Larry Godek W6KQL

Larrt :
Larry Godek W6KQL

Watch our smoke in April!

. . .Ken

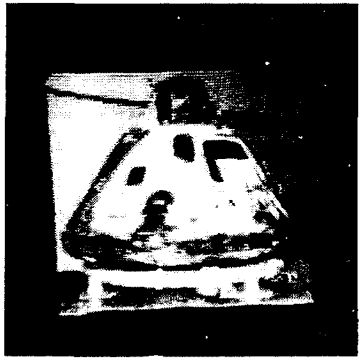
Pro IL

The monkeys who pack your Gunsmoke evidently have been opening the mail for you. Almost a year ago I wrote with my comments supporting incentive licensing, but I noticed it was not included in the "sum total" of supporting statements that you allegedly received.

Paul Schuett WA6CPP

We printed only those letters received after the ACTION coupon was published (which trailed your alleged letter by 9 months). Since last issue we have received additional letters, both pro and con – but those published last issue are still representative, and the mail runs heavy against incentive licensing.

. . .Ken



shortcomings to the pictures. We have to put up with a 120-line picture, but these pictures are certainly crisp and well-rendered within these limitations.

Ralph E. Taggart

Ever since I have gotten my first 73 Magazine I have thought of it to be the greatest publication for the hams. If you don't think I am an old stinker I would like to make one suggestion – *don't print articles "side-ways"* in the 73; such as, the news page, editorial, Caveat Emptor and others. This is not only awkward but detracts from the good image 73 has . . .

Charles D. Stoffel
78 Havenwood Drive
Rochester NY 14622

Is that better?

Score 1 for Autopatch

During the past several years, there has been some rather strong protest from various sides against repeaters and autopatches. I am a commercial pilot and carry my HT with me whenever I fly. I'v worked into repeaters across the entire United States and I can't say I can agree with very many of the objections for these two technological devices.

However, I have a question for the opponents of this form of progress. What price are the repeaters and auto- things were simple oversights or errors as our ad in the same issue calls these things out correctly.

STANDARD COMMUNICATIONS CORP.

Thomas L. Fischer
Vice-President - Engineering

We understand the SR-C826MA is now available, which supersedes the 806 and surpasses it in performance as well. An operational repeater at SAROC using 826 components was impressive indeed.

. . .Ken

On page 96 of the December issue of 73 Magazine, you list specifications for several FM transceivers. Some of the information on the Standard SR-C806MA is in error.

We are a dealer for Standard products and would like to see the errors corrected if possible.

The price of the SR-C806MA is $335 not $349 as listed in the chart. The SR-C806MA comes with crystals for three channels in addition to 146.94 not just crystals for 146.94 as indicated in the chart.

I wish to thank you in advance for your cooperation.

Very truly yours,
ELKO Electronics Specialties
Thomas E. Doyle

The Standard is now being supplied with crystals for .94 direct, .76 direct, .34/.94, and .34/.76. Sorry about the errors!

. . .Ken

Hooray!

You really started off the New Year right with the FB January 1971 issue. I enjoyed *every* article in the magazine, including the front cover! Hope to see more articles on the humorous side, and the same type of cover in issues to come!!

Gordon Bello WA1JWQ
16 Beals St.
Brookline MA 02146

Get HEP!

Your article *Getting HEP to IC's* in the January '71 issue contains several errors. I suspect that these may be primarily the result of trying to simplify and condense a lot of material into a short article, but they should be

If the RS flip-flop has a clock or trigger input, it may be called a clocked RS flip-flop, or an RST flip-flop. It behaves exactly the same as an unclocked RS flip-flop except that the inputs are ignored until a clock pulse occures. A JK flip-flop is just like an RS flip-flop except that the output (Q) inverts when both J and K inputs are *1*'s. a JK flip-flop may or may not have a clock, but usually does.

Again, the ÷2 and ÷4 circuits assume RTL flip-flops since grounding the S and C unputs will not work with DTL and TTL flip-flops.

Let me close by saying that 73 remains my favorite ham magazine, both technically and editorially. Right on! (Write on!?)

E. Douglas Jensen W5OGJ/K4DAD
Senior Digital Systems Engineer
RECOGNITION EQUIPMENT Inc.
Dallas TX 75222

Ham in Trouble

For several months now my ham radio activity has been jeopardized by a local ordinance in San Jose limiting antenna height to 35 ft above the ground.

I have applied to the city for variances to allow for my TH6-DX at 70 ft and my 2-meter collinear array to stay up at 40 ft. The variances have been denied. But at the last appeal the city indicated that I might be right about the fact that sometimes ham antennas should be higher than 35 ft. The city officials suggested I attempt to change the local ordinance limiting tower height. This is what I am working toward now and that is why I need your help.

City officials have stated what my best course of action should be to influence the city council. Of course, the modification of the 35 ft local ordinance will benefit all of the San Jose hams, so I am enlisting their support.

Since I have so many outstanding friends all over the world whom I've experimented with, it was suggested ARRL without any constructive and active solutions.

Joe W6RPX

Stars 'n' Stripes

73 and CQ are the only ham magazines carried by the Stars and Stripes newsstands; all other magazines are only available by subscription.

Under separate cover I am sending you a picture of the new repeater location here in Stuttgart, Germany. Wayne Green once spent an evening in the restaurant above the site.

Hanne Knorr 552-56-1321
Boeblingen AYA SAC-N-21
APO New York 09046

Death of a Rig

I knew very little about the Swan 1011 before reading Ken's editorial in the November issue. It is shocking to hear that a group of "worried" amateurs could talk Swan out of the production of the 1011. Maybe if enough of us who use 20 meters write back to Swan in favor of their rig they will consider putting it back into production. Swan puts out some very fine rigs, and I think that we should encourage them to bring up new ideas instead of tearing apart whatever new that comes out. I'd like to commend "73" and Ken for taking a stand on this issue. Thanks for keeping us informed.

Warren Watson WA0POL
3456 Perry Ave. N.
Minneapolis MN 55422

Optometrist's Conspiracy?

73 has been the only radio ham magazine allowed in this rumpus room of W6VVF for a long time.

It now appears that you are in league with the optometrists to foster sales of eyeglasses to read 73.

To top it off, you have included a comprehensive index to 1970 articles that my trifocal glasses just can't read without the use of an additional magnifying glass!

Having once been a printer's devil, I don't understand why such an important index has to be set up in such fine print when a couple more pages would have made the index easy to use.

I'll continue to read that portion of 73 in the future that I can see but be assured, I am not going to dig through these microscopic ads for goodies. I can read the telephone directory without my glasses so don't prescribe stronger lenses. Try the next size font – larger, not smaller!

W. E. Nichols A/W6VVF

We get a lot more articles in an issue when we reduce the size of indexes and directories. Some advertisers feel they need to use up every square inch of space, too. It must pay off for them, though, or they wouldn't keep advertising in 73. We'll see what we can do for you about increasing the type size of the news pages. Fair enough?

Lobbying

QST has a December editorial saying that a lobbyist is not necessary because – look what has been accomplished by Barry Goldwater as a senator.

Now it strikes me that QST, by pointing to the accomplishments of Barry, has actually defeated its own contention that a lobby is not needed.

If we had a lobbyist, he would attempt to get Congress to do just what Barry has done and more for ham radio. On the other hand, if there is no lobby and no Barry Goldwater in Congress, what would the ARRL have been able to point to in support of their opposition to a lobbyist.

What I am trying to say is that the QST editorial argument supports a lobby.

On the subject of licensing of hams, I go back to the late thirties and later where I argued at RCB meetings that I do not favor more than one type license for amateurs other than Novice because of divisions it would cause among hams. It was bad enough then. I feel very sad at the bickering going on today about who is a lid, who can use what part of what band, etc.

Dave Korpus W2BKP
773 East 46 St.
Brooklyn NY

QST's editorial was indeed contradictory. We have Barry Goldwater, they say, so who needs a lobby? They don't seem to realize that Barry's actions on behalf of ham radio are the actions of a lobbyist. Curious, no?

. . .Ken

WWV via R-4

Keep up the good work with 73. I've been reading it since the first issue. I thought that other hams with Drake R-4 rcvrs might profit from this discovery. To receive WWV without extra crystals:

1. Set rcvr to tune 7.133 AM
2. Rotate preselector to 2.4 on the inner scale.

That's all there is to it! WWV clear as a bell.

Laird Simpson W7AWB/0
8120 Bloomington Ave. S.
Minneapolis MN 55420

Unhappy New Year!

All those who have worked AS3B on CW and have sent their cards to his manager, K2PJG, please take note: You have been taken. No such call as AS3B and K2PJG is not his manager. He cannot possibly write to all those who have sent him a QSL because he is crippled severely by cerebral palsy, and writing is a task for him. And to the person who claims the call AS3B and has caused PJG some trouble, I along with Bob's other friends wish him a miserable New Year.

Dr. G. Schwartzbard WB2IWH
213 Dayton Ave.
Clifton NJ 07011

con't on page 5

Caveat Emptor?

Leaky Lines

by Dave Mann K2AGZ

I got a brainstorm recently and wrote a letter to the office of U Thant, Secretary General of the United Nations. The thought had occurred that since ham radio is an international activity which promotes amity and good will, that perhaps it might be possible to establish a working station at UN Headquarters in New York, with operational privileges for visitors with current licenses. Since the UN constitutes a legitimate international enclave within New York City, as does the ITU within the city of Geneva, I reasoned that perhaps this station might achieve separate country status in the same manner as 4U1ITU, and might be acceptable for DXCC credit. The latter part was an afterthought, to be discussed at some subsequent date. My main target was to get permission from the UN authorities to establish the station.

I pointed out that since this year marks the 25th anniversary of the signing of the Charter in San Francisco, it would be an auspicious occasion for the initiation of such a station. And I asked the Secretary General if we might not be favored with a prompt reply.

The answer came in less than a week, not from Mr. U Thant, but from Josef Nichols, First Deputy Chief of the Communications Section of the Secretariat. He relayed cordial greetings from the Secretary General, and stated that Mr. Thant had expressed warm enthusiasm for the many contributions of the world's amateurs toward world peace and friendship. He en-

Then, of course, the idea hit me, square in the middle of my dumb skull. I have about as much chance of getting any League Committee to agree to a proposal of mine, as Spiro T. Agnew has of being elected Honorary Chairman of the S.D.S.

But I still think the thought has merit, and I still intend to try to get the station established . . . with or without separate country status. It would be a marvelous accomplishment to have a ham station operating at the UN, where the face of amateur radio could be observed by visitors from all over the globe, doing what it does best; establishing and maintaining international cameraderie, good will and peaceful co-operation among all the peoples of the planet. That's more than all the so-called statesmen and all the political geniuses have been able to do.

* * *

Over the last six months or so, ever since one of my close friends popped off that the code requirements ought to be scrapped because they are obsolete, I have conducted a private survey among about 1500 amateurs, selected at random, more or less. My poll consisted of a short series of simple questions, unlike some well-known political polls, not loaded nor designed to result in a predetermined conclusion. I wanted to learn the true facts concerning CW, let the chips fall where they might. And without wishing to appear immodest, I am happy to say that I anticipated the result. By an overwhelming majority

There has been a good deal of discussion pro and con concerning these list-type operations and frankly, I have mixed feelings about them myself, even though I go along with them as a sort of half-a-loaf.

To a great extent these are like the little girl with the little curl in the middle of her forehead. When the net control station succeeds in maintaining his chairmanship effectively, reducing the confusion to a modicum, the hubbub is neutralized, and a surprisingly large number of QSO's is the happy result. But in a number of instances, where the control station has been incapable, either through ignorance or inexperience, of handling the job properly, the ensuing chaos has been horrific. I am sure that these nets, while they may be unpalatable to many, have certainly served a useful purpose to those DX chasers who are not blessed with strong signals by virtue of extravagant antenna systems and ideal locations. From their standpoint the lists have made the difference between a contact and total failure. They could never hope to compete on an equal basis with the big guns on our DX bands.

Perhaps the next time you are tempted to belittle these lists, you might give a charitable thought to all of those who, but for this method, would have precious little chance to realize their hopes of working rare DX. And then, you may enjoy the knowledge that more people are experiencing the satisfaction which ordinarily would come only to those few who are fortunate enough to be able to compete fairly with each other. View it as you would view your golf handicap, and it begins to make more sense.

SWAN 270B with SS-16 filter (shape factor 1.28:1!) factory installed, with Electrovoice 600E mike. $450. Curtis electronic keyer- factory wired with relay $50. All absolutely mint, with manuals, in factory packaging. Marty Barrack WA7PUE, 505D East Country Club Drive, Yuma AZ 85364.

FACSIMILE machines Transmitting and receiving model. 110vac units in operating condition wt. 30 lbs. $16.95 ea. Facsimile paper 500 for $4.25. Send check or M.O. with sufficient postage, excess refunded to R. C. Anderson, 1733 W. Ellen St., Chicago IL 60622.

ELECTRONIC ORGAN, basic spinet kit, transistorized, known make, limited supply, send SASE for particulars. W9YCB, L. G. Hanson, RR 2, Box 52A, Angola IN 46703.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland CA 94607. 451-7755 area code 415.

DERRICK ELECTRONICS HAS ANTENNAS. We'll give the best deals on Hy-Gain, Mosley, Cushcraft, Rohn, Tri-Ex, Easy-Way, Tristao. Box 457, Broken Arrow OK 74012.

MOTOROLA FM – 2 meters; U43GGT, 40 watts output, transistor supply, very clean, with cables and control head, less crystals – $145.00. 80D Transmitter strip – $15.00. Sensicon A Receiver – $20.00. Complete 80D, Dynamotor supply with cables and head – $40.00. WA1INO, P.O. Box 587, Manchester CT 06040.

MILITARY SURPLUS. All new. Electronics, devices, components. Compare and save. Catalog 10¢ (stamps or coin). Electronic Systems, P.O. Box 206, New Egypt NJ 08533.

MODEL 19 TELETYPE, good operating condition, for sale or trade. (202)-234-4678, P. S. Richter, K1SDX/3, 2727 29th St. N.W., Washington DC 20008.

ranges: 3, 15, 30, 150 volts and .06, .6, 3.30 Amperes, Gulton model VAR-101. $24.50. 100 Megacycle vacuum type crystal $5.00. 6 ampere 200 volt Motorola silicon rectifiers 75 cents each. 1 ampere 400 volt, 10 cents each. 100 M.A. 2 inch panel meter D.C. to 50 Megacycles $7.50. 240 volt primary, 24 volt secondary at 10 amps, Barber Colman $6.00. SASE for more items. RHC, 2425 Bradley Road, Rockford IL 61107.

HAM-M ROTOR: Used 1 season, like new. First $59 takes it. D. Steele VE7BCX, 1732 Brookshire, Tustin CA 92680. 714/878-3495.

HT-2 VARITRONICS HANDIE-TALKIE: Unused, perfect, complete. First $159 takes it. D. Steel, VE7BCX, 1732 Brookshire, Tustin CA 92680. 714/878-3495.

FACSIMILE TRANSCEIVERS Mod. TXC w/110 V.A.C. – P.S. Good cond. $175. each. Facsimile Rec. Mod RD-92/UX w/110 V.A.C. – P.S. Good Cond. $100. each. News Clark Telemetry Rec. Type 14-12 New & Unused. Timefax electrostatic rec. paper $5./roll. Charles Moss, Rt 1, Box 411, Mt. Shasta CA 96067.

THE SPRING AUCTION of the **ROCKAWAY** Amateur Radio Club will be held Friday evening April 23rd at 8 P.M. at the American Irish Hall, Beach Channel Drive at Beach 81st Street, Rockaway Beach, N. Y. Come to the best Auction in the New York area. For further information write to Al Smith, WA2 TAQ, P.O. Box 341, Lynbrook NY 11563.

WANTED, MAN WITH 2nd CLASS PHONE TICKET or better to work in 2 Way radio sales & service with option to buy business. Am Distributor for E. F. Johnson F.M. & Motorola Service Station. No smoking habit preferred. Walt Fairbrother, 29 Alden St., Greenfield MA 01301. Ph. 413-773-5063.

dorsed the spirit of international cordiality which has always been so marked a part of amateur radio. Unfortunately, the letter went on, they could not consider establishing such an operation at this time, since the expected visits of many heads of state would tax their security facilities to the limit. My proposal was highly acceptable at some time in the near future, but, regrettably, it must be declined for the period of the celebration. Hence, the door to such an operation has been flung open, to be acted upon when the time is more propitious.

In mentioning the matter to other hams, I discovered a great deal of skepticism concerning ARRL DXCC Committee's willingness to consider granting any separate country status to such an operation. This puzzles me, for several precedents have been established which leave the way clear. United Nations Headquarters is certainly no different than ITU, Geneva, or even HV, the Vatican, both enclaves within larger political entitites. If there were a refusal to grant status, it would be highly inconsistent. In what possible way does New York differ from Geneva or Rome?

HOBBYISTS – Electronic components at huge savings. Transistors, 2N3566 and 2N3567, 6 for 25¢ 2N3638, 4 for 25¢ capacitors 10¢ carbon resistors 5¢. Thousands of components. Catalogue free. SASCO Electronics, 1009 King St., Alexandria VA 22314.

TRANSCEIVER, SR-150 and power supply P-150 AC, complete with crystals for five bands and calibrator, excellent condition. Turner SSB mike, new. $300 plus shipping. McFolin, WA4WRU, 710 Dellwood Rd., Huntsville, AL 35802.

the continued use of code is endorsed wholeheartedly. Even confirmed phone men who rarely, if ever, use telegraphy, expressed what I like to think was a sentiment, rather than merely an opinion. They would not care to see CW fade into limbo like the horse and buggy or the old fashioned waltz.

One thing I noticed almost universally among those who had to 'fess up that they hadn't been on CW for years. They all vowed solemnly that "One of these days I'm gonna get out the old bug and get back on CW, because the phone frequencies are starting to become a real rat race." It seems that even those who suggest that less emphasis on CW is now in order, invariably add, somewhat wistfully, "There was a time I could copy forty per minute without any trouble at all." Somehow all hams seem to find a source of real pride in that accomplishment, and are a bit ashamed to admit that they have allowed their skill on CW to atrophy.

Yes, my little survey clearly shows, despite all arguments to the contrary, that far from being ready for the boneyard, CW is a lusty, healthy, living part of our hobby, still very much utilized both for its usefulness, and in a way even more importantly, for the sheer fun and pleasure of it.

* * *

I am an enrolled, card carrying member (what am I saying?) of three or four of those recently organized nets which have been formed for the purpose of facilitating DX contacts, so that those foreign operators who are intimidated or otherwise frustrated by horrendous pile-ups will be able to minimize their difficulties and work a few QSO's.

Letters con't from page 4

A comment on the formulas on page 28 of your November issue for calculating electrical lengths.

The formula used in both cases by W6AJZ is one which has already been corrected from the free space calculation by some 5%, for length/diameter, and end effect. It is the one commonly used for wire antenna dimensions. To apply velocity factors, which are a ratio to the free space dimension, is therefore incorrect, in this case.

Correct formulas are 369/f (MHz) x V for the 3/8 wavelength, and 492/f (MHz) x V for the 1/2 wavelength.

Owen Jackson OA4MS.

I confirm that the formulas should read: for the 3/8 wave stub = 369/f (MHz) x V; and for the coupling line = 492/f (MHz) x V x m, where "m" equals the multiples of half-waves required to reach from antenna to operating position. The "m" was typographically misplaced in the first formula in the printed article.

I think the fact that some local W6s successfully applied the erroneous formulas is accounted for by the short line length they used . . . only ½ wavelength, which minimized the affect of error. Longer line multiples of "m" would undoubtedly lead to grief.

Ring up one shameful boo-boo to W6AJZ; and my thanks to OA4MS for showing me the error of my ways.

W6AJZ

What do you suppose they're up to now?

EDITORIALS CONT.

W2NSD/1 cont. from News Page 1

time to start a new publishing effort so Mike will need all the help and cooperation he can get.

When you consider that Mike is undertaking this all on his own with no support beyond good wishes from any of the amateur magazines you can see that he has his work cut out for him.

THAT QST EDITORIAL

In December the unsigned QST editorial defended the ARRL position that amateur radio needs no lobby in Washington to protect the hobby. They attributed my concern about this to an effort to build up the circulation of 73. That allegation ill befits them.

Amateurs who took the time to read the QST editorial carefully and thoughtfully may have recognized the illogic of their argument. Actually they made an extremely strong case in favor of a Washington lobby for amateur radio. In essense, they said that since we have Goldwater in Congress, a lobby is not needed. It was Goldwater who broke the ice with the reciprocal licensing bill. . .Goldwater who was responsible for the effort to license aliens. . .etc.

Senator Goldwater is providing some of the functions of a Washington lobby for amateur radio. . .true. But Senator Goldwater has been sent to Congress by the people of Arizona and it is to them that he owes his primary efforts, not to us. If he has time left over, we are benefited. . .if not, well, too bad.

We have but to remember back to the years that amateurs worked toward getting that reciprocal licensing bill into Congress . . .to no avail. Without Senator Goldwater I doubt seriously if we would be any further along in getting reciprocal licensing today than we were ten or fifteen years would irritate congressmen shows a profound misunderstanding of the lobby function. Their insistence that Congress has little power to help amateur radio is downright appalling.

The fact is that the FCC recently jammed through a 125% increase in the amateur radio license fee and the ARRL was completely powerless to stop it. They demonstrated that they have no clout where it counts. The increase was unreasonable and should never have happened. You can bet that the AOPA would never let anything like this happen to the pilots or the NRA permit such a catastrophe to hit their members.

Read that editorial again when you get a chance and see what you think of it now. Maybe you will join the "Drumbeaters."

Is 1971 the year when ARRL members will start taking an interest in amateur radio and will vote in some new directors? That is where you have to start if you are going to make a dent in the conservative core at HQ.

NEW FCC FORM 610

The FCC has announced that effective July 1, 1971 they will no longer accept 610 forms which are dated July 1970 or later. The form 610 is for applying for an individual amateur radio station and/or operator license.

NEW THREAT TO 220

The Electronics Industries Association is petitioning the FCC to take the 222–224 MHz amateur band and turn it over to CB, removing it entirely from amateur use. They further are asking that the amateur frequency allocation be changed so that one class can use 220–222 and another class use 224–225 MHz!

The following companies are financially supporting the EIA program:

K6MVH cont. from News Page 1

me tacos or enchiladas. It was tacos for supper with WB6AOF, tacos for lunch with W6NOS; enchiladas for lunch with WB6IGZ, then an enchilada dinner with WA6BOF and K6VBT. When I visited my mother in Boulder City, I was going to tell her about my "forced" Mexican food diet, but I didn't have the heart. When I walked into her house, a surprise party was under way for me. In case you haven't already guessed, the "party" was in the form of a taco feed.

It's a real pleasure to be home again, here in Peterborough. And clam chowder never looked better!

A Big One in Texas

It looks like it's getting to be convention season; particularly with respect to VHF operation. The hottest thing on the calendar right now is the First Annual Southwest Regional VHF Conference, slated for March 21 and 22 at the Sands Motel on West Hwy 80, in Midland Texas.

The fellows at Standard Communications (both hams) showed their new superselective transceiver and demonstrated a repeater made from Standard transceiver parts.

Tickets are modestly priced at $2 for the conference, $1 for the Saturday evening dance, and $2 for the Sunday swapfest. I don't know exactly what's on tap for the conference program, but I will be there as either speaker or "open-forum" participant.

According to Paul Storm (WA5RAG), president of the Midland club, door prizes will be awarded at the dance and the swapfest. In addition, prizes will be awarded for CW, frequency guessing, homebrew equipment (no kits), etc. Talk-in frequencies will be 7270 SSB and 146.94 FM. (The local repeater is .34/.94.)

Advance registrations may be sent to MARC, Box 967, Midland TX 79701.

Speaking of Conventions

Wayne and I are occasionally invited to speak at conventions or hamfests, and we nearly always accept. But invariably, we attach a string to it so that 73 doesn't go broke paying air fares. What we require is sufficient guaranteed subscription sales to cover expenses for the trip. That way 73 picks up the tab, but the money comes from the area we visit. The whole thing generally works out quite satisfactorily for everyone.

NEW PREFIXES IN GERMANY

In addition to the existing call sign prefixes the German postal authorities now issue the prefixes *DA, DB,* and *DF.* There are now the following call signs:

ago. Someday I hope that John Barrows, (W6ECS) the chap who spent more time than anyone else in the world trying to get reciprocal licensing enacted, will write a history of that effort. His major opponent in this was none other than ARRL HQ which was, at the time, vigorously fighting anything that they did not originate. I will leave it to your objectiveness as to whether they have changed in this attitude.

I have talked with Senator Goldwater about the importance of our lobbying for amateur radio and he has been most helpful in suggestions to this end. We do need to make sure that all congressmen know what amateur radio is and how it differs from the citizens band and other services. Amateurs are making enough news for us to get congressmen to enter items in the Congressional Record frequently. This is one paper that every congressman reads every day. Mail and handouts seldom get through the assistants, but the Record does.

The CBers have begun to find out how important congressmen can be to their efforts to get the FCC to listen. At the November 20th confrontation between the FCC and representative CB groups in Washington I doubt if the FCC representatives would have done more than politely listen to the CB pitch for more frequencies, more power, higher antennas, and legal hamming. But there were a number of congressional representatives there and the FCC *did* listen. I was there to watch that important meeting. Amateurs have never held such a meeting with the FCC, have they?

As of mid-January the powerful Electronics Industry Association still intends to petition the FCC to follow the CQ Magazine plan and turn 146–148 MHz over to CB. This is in addition to their 222–224 MHz petition for CB channels. Can we hold our frequencies against this formidable combination of a well funded and experienced Washington lobby plus a large number of cooperating CB groups who have the ear of their congressman? Senator Goldwater has his work cut out for him and I hope Arizona doesn't need anything serious soon.

The QST editorial is slanted. The use of such emotional terms as major clinker . . .pointless idea. . . expensive . . .dangerous. . .with reference to the proposed Washington lobbyist is scarcely honest rhetoric. Their inference that a lobbyist

Amphenol
Antenna Specialists Company
B & K Division of Dynascan
Browning Laboratories, Inc.
CTS Knights, Inc.
Courier Communications
Demco Electronics
Echo
E. F. Johnson Company
Hallett Manufacturing Company
Hallicrafters Company
Heath Company
Hy-Gain Electronics Corp.
Kaar Electronic Corp.
Lafayette Radio Electronics
Midland International Corp.
Mosely Electronics
Olson Electronics
PACE Communications Corp.
Raytel Division of Raytheon
Regency Electronics
Rohn Electronics
Squire Sanders, Inc.
Texas Crystals
Turner Microphone Company
World Radio Lab

The above companies are CB manufacturers, though a few are also in the amateur field. In all it is a formidable group backing this proposal.

Keep in mind that the EIA is centered in Washington and knows its way around when it comes to lobbying. Keep in mind that amateur radio has no lobby whatsoever and thus has no way to effectively oppose any pressures that can be brought to bear. What will the outcome of this one-sided pressure to completely take away this amateur band? Since you have nowhere to turn for help, if this is of any importance to you, you are forced to do something about this yourself. But what can you do?

First of all you must understand the issue and what is at stake. The complete text of both the EIA proposal and RM-1633, the only alternative so far filed with the FCC, will be published at the end of this editorial so you can judge for yourself the factors involved. 1633 asks for the establishment of a new class of amateur license, requiring only a knowledge of rules and regulations, which would use the middle 4 MHz of the 220 band. This was proposed as a plan for bringing more new amateurs into our hobby via the VHF FM route. The band would still remain open to all amateurs and no frequencies would be taken away from amateur radio.

While many amateurs may not agree 100% with the proposals of 1633, some feeling that the new class of license should demonstrate at least 5 wpm code ability, others feeling that a Novice level of theory should be required, the entry of the EIA proposal would appear to virtually eliminate the possibility of such options, and reduce the problem facing the amateur to chosing one or the other of the two alternatives. There is a good possibility that even if amateurs are in 100% agreement (which would be historic) that they still would not be able to stop the EIA juggernaut.

Practically speaking, your choice would seem to be either a support of the EIA proposal through your silent submission, or an active fight to put through RM-1633.

VERON

25th ANNIVERSARY

The Dutch national society, VERON, celebrated 25 years of service to the radio amateur at a "Day of the Amateur" held on 15 November 1970 at Philips Ontspanningscentrum (recreation center) at Eindhoven.

After opening speeches by the president of VERON, A. H. J. Claessen, PAØCLA, and the president of the Eindhoven district club, members heard a lecture by Dr. J. A. Saxton, president of the RSGB, entitled *Amateur Radio and Propagation Research*. Dr. Saxton, who is director of the UK Radio and Space Research Station, spoke of the past achievements of amateurs in the field of propagation research and emphasized the need for continuing vigorous work in the future.

Nearly 300 members attended during the day and the success of the meeting was assisted by the excellent facilities of the Philips center.

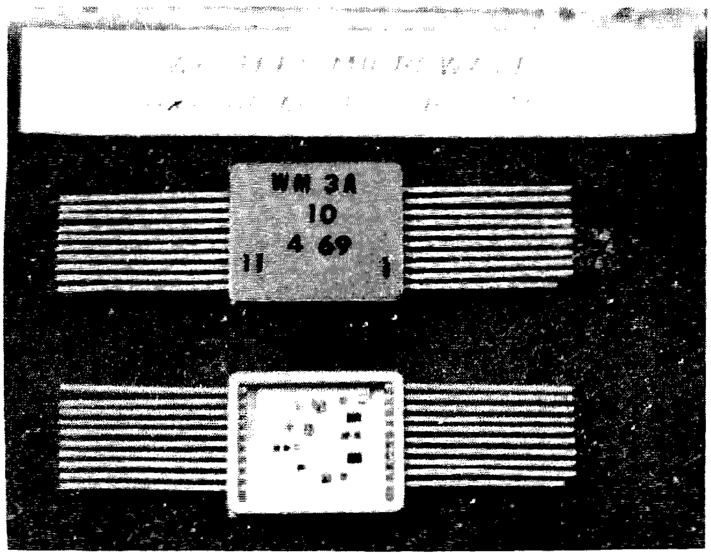
		License Class
DA 1 AA – DA 2 ZZ	Amateurs of Foreign Armed Forces	A + B
DA 4 AA – DA 4 ZZ	Amateurs of Foreign Armed Forces	C
DB 1 AA – DB 9 ZZ	German amateurs	C
DC Ø AA – DC Ø EZ	German amateurs	C
DC Ø=FA – DC Ø JZ	Foreign civilians	C
DC Ø KA – DC Ø ZZ	German amateurs	C
DC 1 AA – DC 6 ZZ	German amateurs	C
DC 7 AA – DC 7 ZZ	German amateurs in West Berlin	C
DC 8 AA – DC 9 ZZ	German amateurs	C
DF 1 AA – DF 9 ZZ	German amateurs	A + B
DJ 1 AA – DJ Ø ZZ	Foreign civilians	A + B
DJ 1 AA – DJ 9 ZZ	German amateurs	A + B
DK Ø AA – DK Ø ZZ	German club stations, special call signs	B
DK 1 AA – DK 9 ZZ	German amateurs	A + B
DL Ø AA – DL Ø ZZ	German club stations, special call signs	B
DL 1 AA – DL 6 ZZ	German amateurs	A + B
DL 7 AA – DL 7 ZZ	German amateurs in West Berlin	A + B
DL 8 AA – DL 9 ZZ	German amateurs	A + B

USSR PREFIXES

Prefix Club Stations	Prefix Individual Stations	Prefix Individual vhf Stations	
UK1	UA1	RA1	European USSR
UK2	UA2	RA2	Kaliningrad
UK2	UC2	RC2	Byelorussia SSR
UK2	UQ2	RQ2	Latvian SSR
UK2	UP2	RP2	Lithuanian SSR
UK2	UR2	RR2	Estonian SSR
UK3	UA3	RA3	European USSR
UK4	UA4	RA4	European USSR
UK5	UO5	RO5	Moldavian SSR
UK5	UB5	RB5	Ukrainian SSR
UK6	UG6	RG6	Armenian SSR
UK6	UD6	RD6	Azerbaijan SSR
UK6	UK6	RF6	Georgian SSR
UK6	UA6	RA6	European USSR
UK7	UL7	RL7	Kazakh SSR
UK8	UH8	RH8	Turkomen SSR
UK8	UJ8	RJ8	Tadzhik SSR
UK8	UM8	RM8	Kirgisk SSR
UK8	UI8	RI8	Uzbek SSR
UK9	UA9	RA9	Asiatic USSR
UKØ	UAØ	RAØ	Asiatic USSR

John Schultz W2EEY/DL
40 Rossie St.
Mystic CT 06355

A view of an encased WM3A filter and one with part of the casing removed to show the internal hybrid integrated circuitry. The encased filter measures only 8/10" x 7/10" and is about 3/16" thick. Photo courtesy Western Microwave, Los Gatos CA 95030.



INTEGRATED CIRCUIT AUDIO FILTER

The development of complicated multi-inductor filters and multi-transistor rc filters is culminated in a new type of integrated curcuit audio filter. The filter should have many applications in amateur radio equipment designs.

One item that has been used in innumerable pieces of amateur equipment and accessories over the years is an audio filter. Such filters, particularly if they were used for audio selectivity purposes, could get to be very elaborate and large with multiple section designs. It was probably only inevitable that the current stream of progress toward the micro-miniaturization of electronic components would also reach audio filters. However, the miniaturization of audio filters that has been achieved is not just simply a miniaturization of inductors and transformers. None of these components are used in the audio filters to be described, and these integrated circuit filters offer adjustment versitility that could never be achieved with inductors. Such filters open up the possibility for the construction of numerous compact pieces of accessory equipment that can be used to improve the operation of receivers and transceivers.

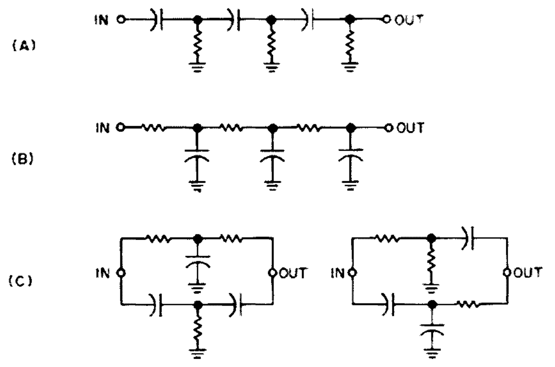


Fig. 1. Basic rc networks allow filter circuits to be built without the use of inductors. High-pass circuit (A), low-pass circuit (B), and notching and peaking circuits (C).

Background

Many attempts have been made to do away with the use of inductors in filters both because of size and cost factors. Some of these attempts date back quite a few years and all revolve about the use of rc networks in place of inductors. For instance **Fig. 1(A)** shows an rc high-pass filter. As the frequency of the input signal increases, the reactance of the capacitors decrease and more voltage appears across the output. **Fig. 1(B)** shows a low-pass filter that works in a similar manner. If you combined the filters, using an amplifier for each, you could form a bandpass filter. You could also combine various forms of rc networks to form notching or peaking filters, as shown in **Fig. 1(C)**. Such filters by themselves, of course, are crude and provide poor selectivity. Usually such filters are used together with amplifier stages to compensate for the filter attenuation and also in feedback arrangements so the filter

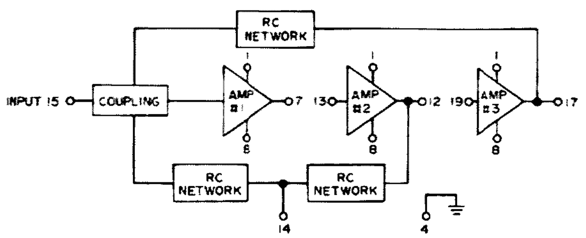


Fig. 2. Block diagram of the Western Microwave WM3 filter. ALL of the blocks shown are contained in the single filter unit shown in the photograph. Each amplifier is, in fact, a separate integrated circuit amplifier. The numbers refer to the terminal connections.

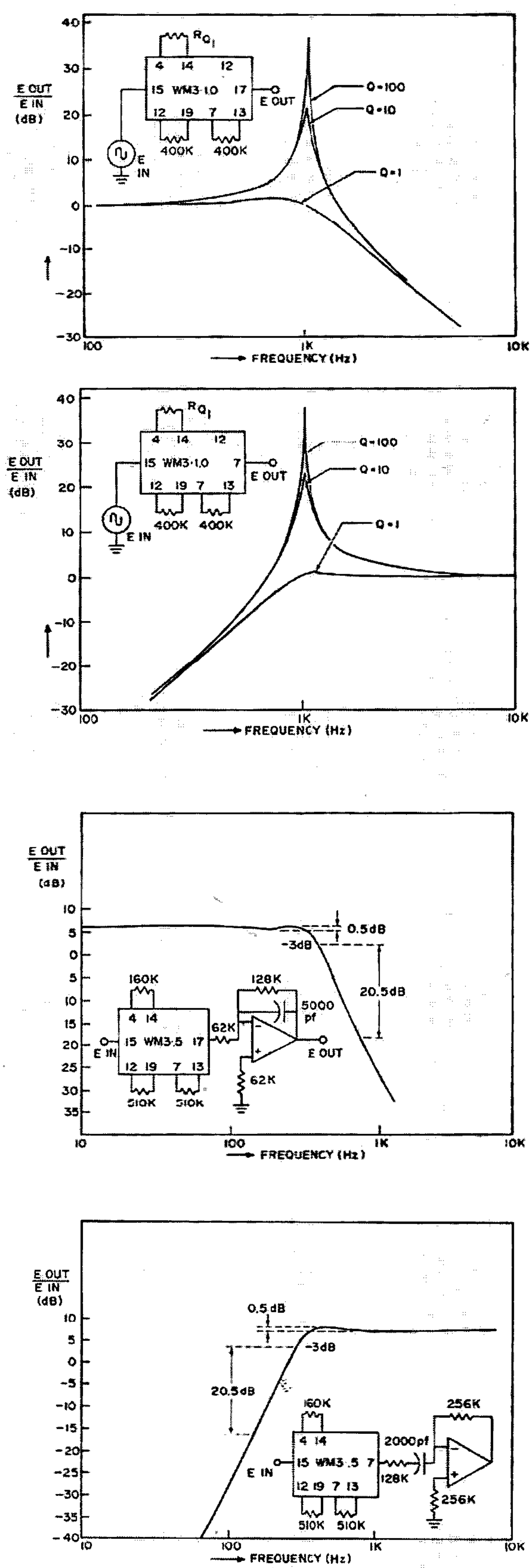


Fig. 3. The WM3 filter can be used alone [(A) and (B)] to function as a low-pass or hugh-pass filter or in conjunction with a postamplifier [(C) and (D)] to produce a steeper slope at the cutoff frequency.

circuits are not loaded down. Unfortunately, by the time you combine sufficient discrete component rc networks and transistor amplifier stages to have the rc filter duplicate the performance of an inductor network, the rc filter can be as large and as costly as the latter. The advent of integrated circuits has changed all that, however. High gain amplifier circuits and multiple rc networks can be incorporated in one physically compact unit.

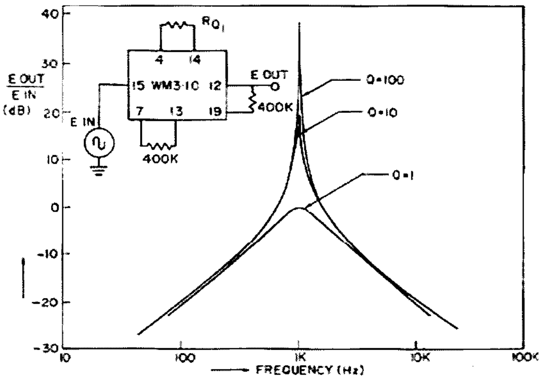
The block diagram of the integrated circuit filter is shown in **Fig. 2.** Three multi-transistor operational amplifiers and the necessary rc networks in a feedback arrangement are combined in the hybrid filter unit. Three external resistors are used and can be manipulated to change the operational characteristics of the filter. One can see some of the filter components in the unencased view of the filter in the photograph. The encased filter measures 0.8 inches x 0.65 inches x .15 inches thick. The surface area is about that of a 25 cent piece, and it is hardly any thicker.

Performance

The filter really begins to shine when one investigates its performance possibilities. It can be used as a high-pass filter, low-pass filter, peaking filter, notching filter, etc. The center frequency can be adjusted as desired by an external potentiometer as well as the Q if desired. The unit can also be set up so you can switch select a variety of different filter effect outputs.

Graphs portray the performance of this type of filter best. **Fig. 3** illustrates the output versus frequency characteristic of the filter in several low-pass and high-pass circuits. The filter can be used alone for these functions, or its output used to drive another ic operational amplifier power stage to further increase the slope of the frequency response at the cut-off frequencies.

Fig. 4 shows the filter used as a peaking or notching filter. Note the extreme



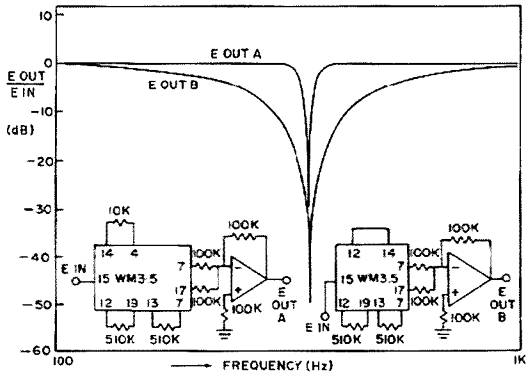


Fig. 4. The extremely sharp peaking and notching characteristics of the filter make it ideal for use as an cw selectivity device. The peaking and notching frequencies can be tuned from 500 to 1500 cycles.

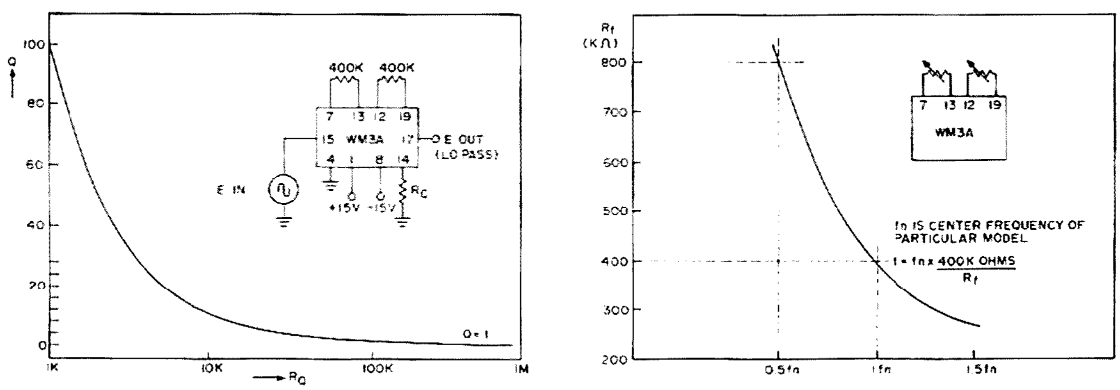


Fig. 5. The above graphs indicate how by simple external potentiometer control, the frequency as well as the Q of the filter can be varied.

sharpness of the response at the nominal center frequency of 1 khz. Actually, both the center frequency as well as the sharpness of the filter response can be tuned by making various of the external resistors variable as shown in **Fig. 5**. Thus, the center frequency of a nominal 1khz filter can be tuned from about 500 to 1500 cycles. The Q can be varied from about 1 to a maximum of 100.

As might be imagined from looking at the arrangement of the external resistors and the output terminals used for each specific application of the filter, you can devise various switching arrangements to select different outputs, different specific center frequencies, etc. The possibilities in this direction are pretty well only limited

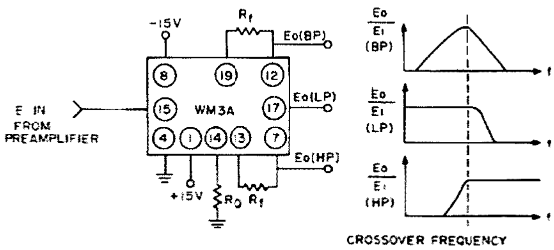


Fig. 6. The above diagram illustrates how the filter can be used to simultaneously produce different output characteristics. Rf and Rq are chosen according to Fig. 5.

by your imagination. **Fig. 6** shows one simple circuit which provides simultaneous or switch selected different output possibilities.

Summary

The type of filter described is available now from firms such as Western Microwave. The price of such a filter–about $30 depending upon the type of casing used–will restrict its use in amateur equipment until greater sales will invariably bring the price down to that of regular integrated circuits. However, even though one may not be using such a filter tomorrow, such filters will be the type of component that will become common in amateur equipment as the micro-miniaturization of components for use if communications circuits continue.

. . . W2EEY

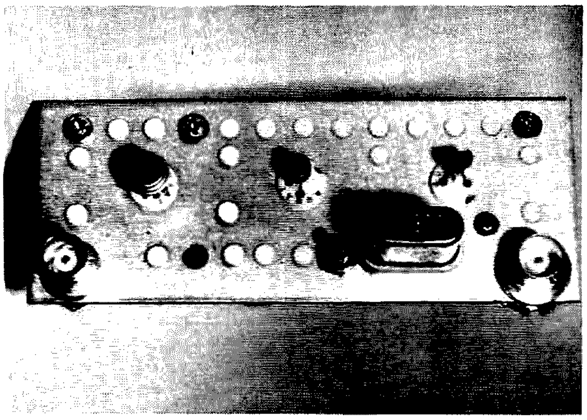
Edward Levy WB4KMB
7441 Wayne Avenue, 14 B
Miami Beach, FL 33141

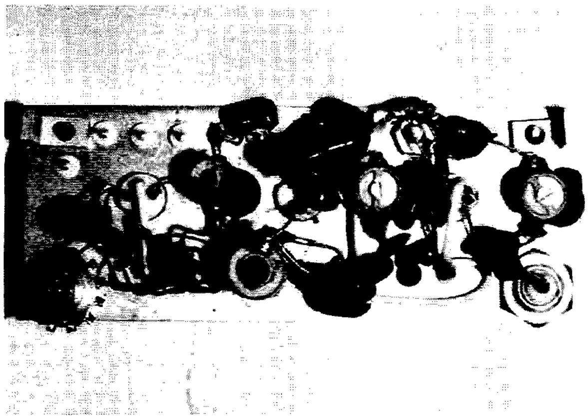
INTEGRATED CIRCUIT 6 METER CONVERTER

At the present time, amateur 6-meter converters are built around nuvistor tubes or field-effect transistors. The former requires a b-supply in the order of 100V and filament power; both types usually require neutralization, which is tedious and requires additional components.

The 6-meter converter described in this article uses an integrated circuit in the front-end, eliminating the need for neutralization and yielding far better gain characteristics than the nuvistor or all-FET counterparts.

The amplified 6 meter signal is mixed at the gate of a 2N3819 FET mixer with the local oscillator signal, generated by a crystal controlled 2N3819 FET overtone oscillator operating at 49.5 MHz This produces a difference frequency of 1.0 MHz which is in the middle of the broadcast band, making the converter ideal for mobile applications. If a 7 MHz difference frequency is desired, a 43.5 MHz crystal is used and the 3900 pf capacitor is the mixer drain tank circuit is changed to 100 pF





Circuit Description

This converter uses a CA3028A integrated circuit in the rf amplifier, which is connected in cascode configuration. The cascode circuit behaves as a pentode tube, and thus prevents tendencies toward oscillation. These tendencies are further reduced by using toroidal coils, which prevents generation of stray magnetic fields and eliminates the need for shielding the input from the output tank circuits.

The converter has a gain of 36 dB up to the mixer drain tank circuit. However, since the tank circuit is high impedance, a link coupling must be used to match to the receiver input impedance, which is usually in the order of 50 ohms. The link consists of three turns of no. 22 wire around the mixer drain tank coil. Matching losses are unavoidable, but a gain of 24 db can be achieved without much difficulty. Typical bandwidth is 100 kHz.

Alignment

With a VTVM connected at the oscillator gate, tune the oscillator tank circuit for maximum negative voltage. Remove the VTVM, and connect an oscilloscope at the mixer drain terminal. With a 1mV 50.5 MHz signal connected at the input, tune the output tank circuit of the rf amplifier for maximum signal. The signal at the mixer drain terminal should be sinusoidal, at a frequency close to 1 MHz if it is not sinusoidal, detune the oscillator plate tank circuit slightly. Now tune the mixer drain tank circuit for maximum signal, and tune the rf amplifier input and output tank circuits for maximum signal.

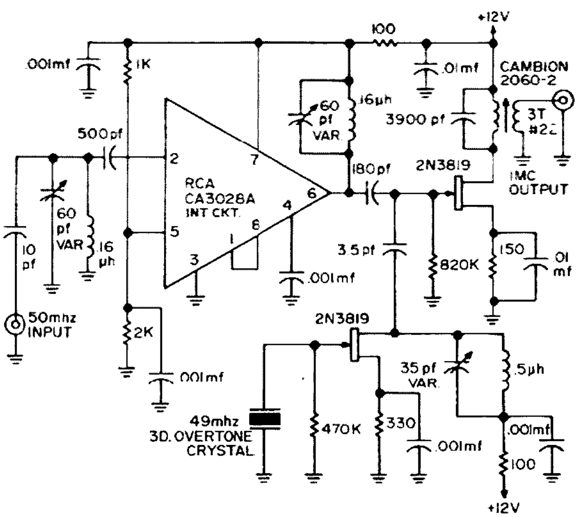


Fig. 1. Schematic

Construction Details

The converter was built on a piece of aluminum, with teflon sockets and terminals used for mounting components, although if built on a punched phenolic board with standard terminals the circuit will work as well. The only precautions to observe are making the connections as short as possible and to keep the coils well separated from each other.

The toroidal coils are not visible in the photographs because they are mounted under the trimmer capacitors.

The converter costs less than $20.00 in parts and outperforms by far many of the commercial units that are presently available for almost twice the cost.

. . . WB4KMB

Trap-Type VERTICAL Antenna

The addition of a few stubs can add effective 2 meter operation to most trap-type vertical antennas without degrading the regular performance of such antennas and without requiring any change in transmission line connection.

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Usually one erects a trap-type vertical antenna for use on the lower frequency bands because of antenna space restrictions. When carefully adjusted, such antennas are capable of reasonably good performance. Many operators who use such antennas would also like to have some antenna facility for operation on a vhf band—particularly 2 meters—and look fondly at the trap vertical structure trying to visualize how advantage might be taken of its height, etc., for use on 2 meters without erecting a completely separate antenna installation for the latter band. One could mount some small two meter antenna, such as a ground plane, on top of the trap vertical, but structural problems are involved with the relatively thin upper section of the trap vertical, a separate transmission line required (or a changeover relay to the trap vertical transmission line), and the basic trap vertical performance may be affected. A much better solution to the problem, of course, is to somehow utilize the trap vertical antenna itself as an antenna array with a low loss transmission line, such as RG-8, if it has been properly installed. So, there is no problem with the basic transmission line run to the antenna for use on two meters. The problems which do exist are with the trap vertical antenna itself as to how it can be modified into a useful antenna form on 2 meters that will correctly match the transmission line.

This article presents an easy method of modification that can be used with most trap verticals which permits use of the antenna on 2 meters while operation of the antenna on its basic design frequencies is not affected.

Basic Antenna Considerations

The usual trap type vertical can be electrically represented as shown in **Fig. 1(A)**. The various tuned circuits isolate sections of the antenna on different bands such that the basic antenna structure always remains a ¼λ vertical. Above their resonant

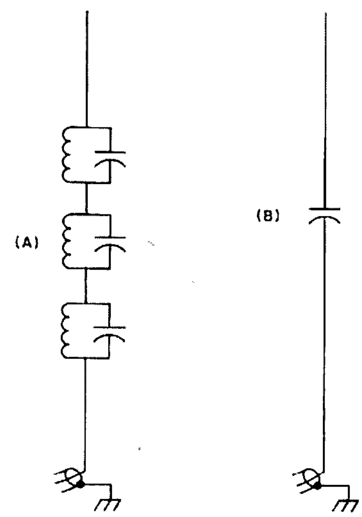


Fig. 1. Multiband trap type vertical antenna (A) forms a vertical antenna which can be represented as at (B) when operated on a frequency which is several times higher than its highest normal operating frequency.

frequencies, each tuned circuit would present a capacitive reactance. Thus, if the antenna were operated on a frequency several times higher than the resonant frequency of the highest frequency tuned circuit trap, the antenna could be electrically represented as shown in **Fig. 1(B)**. The capacitive reactance still present would be very small because of the frequency being considered, although the series effect of the equivalent capacitors from the individual tuned circuits works to increase the total reactance on 2 meters. The total reactance

present on 2 meters depends upon the number of traps used in the antenna and their specific parameters, but it can be as low as 30 ohms in a typical antenna.

For the moment, it can be considered that the series capacitive reactance on 2 meters is insignificant, and the antenna acts as a straight rod. If the antenna were excited on 2 meters, a situation similar to that shown in **Fig. 2(A)** would result. If the total length of the antenna happened, by chance, to be correct, it might still match the transmission line impedance. The chances of such an event taking place are rather small, however. Even if it were to occur, the total length of the antenna would be such that a number of current reversals (one every ½λ) could take place. Since the currents in different sections would be out of phase, the resultant radiation pattern would split into a number of lobes in a manner similar to that for a long wire antenna. The result would be radiation and useful for little more than communicating with an aeronautical mobile station directly overhead.

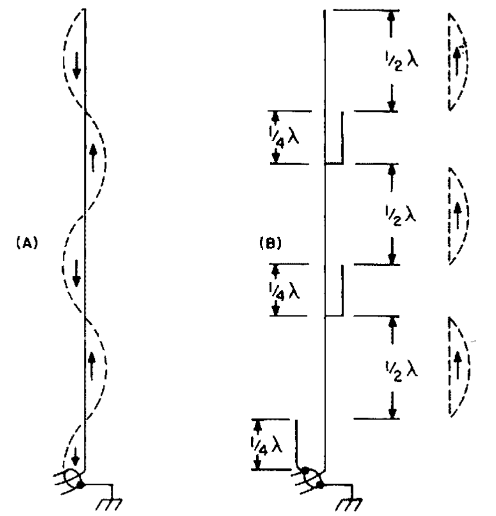


Fig. 2. Exciting a multiband antenna on 2 meters without any modifications being made to the antenna may produce some useful radiation but usually the antenna will not impedance match the transmission line and the current distribution on the antenna (A) will produce mostly useless high angle radiation. Both correct impedance matching and correctly phased current distribution for effective low angle radiation can be achieved by the use of a few simple stubs (B).

Stub Placement

The use of a few simple ¼λ stubs on 2 meters can provide both proper matching of the antenna to the transmission line and correct phasing of the antenna currents. This situation is illustrated in **Fig. 2(B)**. Note that the stub on the bottom of the antenna is connected differently than the other stubs. The "closed" end is connected to the ground terminal (shield of the transmission line) and not to the antenna (center conductor of the transmission line). Calling it a "stub" is actually a misnomer since it functions on 2 meters as a quarter wave transmission line transformer to match the low impedance of the transmission line to the high impedance of the first ½λ section of the antenna. The operation is the same as the well-known "J" antenna. The other stubs cause a phase reversal between the ½λ sections so that the currents in each section line up properly. The result is that a radiation pattern is produced which is omnidirectional in the horizontal plane and also which has several db of gain with low angle radiation in the vertical plane.

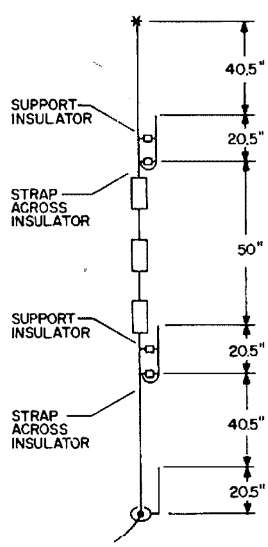


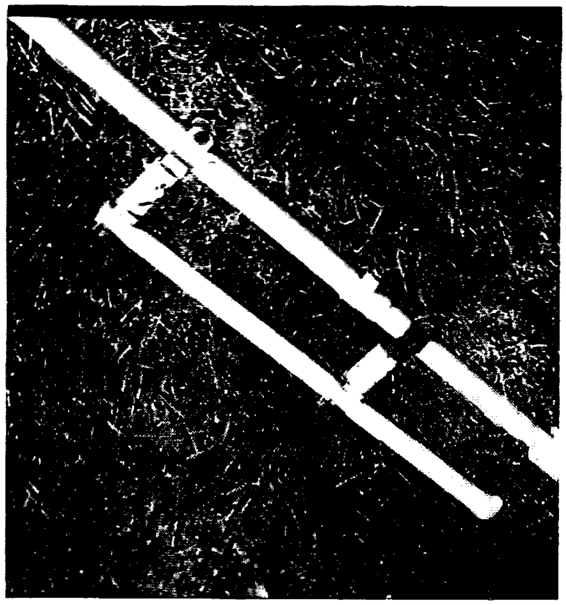
Fig. 3. Dimensions of stubs and placement for two meter operation of a typical hf multiband trap vertical antenna.

Fig. 3 shows an example of how the scheme of **Fig. 2(B)** was used with a 14AVG trap vertical (remove the rf choke in the base connector). The matching stub is simply ground end connected to one of the mounting bolts on the antenna base connector. A standard pillar insulator (Birnbach 440F) with pipe clamps on each end is used to support and insulate the other end of the stub. The other stubs are mounted in a

similar manner but using two insulators with a shorting strap across the bottom insulator. The photograph illustrates the construction used. The spacing of the stub is not critical nor is the diameter of tubing used for the stub. In the example shown, a center to center spacing of about 3½" was used and ¾" aluminum tubing for the stub.

The second stub (first phasing stub) is placed ½λ above the end of the matching stub. This stub can be placed below the first trap on almost all trap verticals which are designed for use down to 10 meters. The second ½λ section will encompass the physical length of all the traps in the usual 2 or 3 trap antenna, since these traps are placed relatively close together. As was mentioned before, however, the traps will still act to present some capacitive reactance on 2 meters. Therefore, in order to effect an electrical ½λ section, the physical length between the first and second phasing stubs must be made longer. In the example shown, the length required was about 50" which placed the second phasing stub just above the top trap. The last ½λ section above the last phasing stub is formed by the remainder of the antenna. Usually, the necessary length can be secured by slight adjustment of the top section length or adding to the capacity top-hat on the antenna. A slight adjustment of this length does not affect the antenna performance on the hf bands, since the length is not effective except on the lowest frequency used. The stubs themselves are insignificant electrically when the antenna is used on the hf bands. The physical placement of the small stubs does not in any way affect the mechanical strength of the antenna structure.

The only question about adjustment that may arise is the spacing to use between the first and second phasing stubs in order to allow for the capacitive reactance of the traps. Probably the easiest way to determine the correct length is to temporarily remove the section of the antenna above the top trap. Then using a field strength meter placed at a height equal to about the middle of the antenna and as far away as possible, the antenna is excited and various lengths of top section tried for maximum field strength indication. The regular top section is then replaced and the bottom of the second phasing stub placed a distance above the top trap equal to length just found necessary to peak the field strength reading. The last ½λ section above the top phasing stub is determined by direct measurement. In case the dimensions of a trap antenna are such that a stub would fall between traps, the same procedure as just described using a field strength meter should be followed to peak any ½λ section which contains a trap.



Two standard pillar insulators are used to support the ¼λ stub. Note the shorting strap across the lower insulator. The spacing of the stub from the antenna is not critical and is shown as being about 3½".

Summary

Most trap verticals can be modified at minimum expense into very effective 2 meter antennas by the method described. The performance will easily equal or exceed that which would be effected by placing a ground plane antenna at a height equal to the top of the trap antenna. The swr will remain reasonably low over most of the 2 meter band but can be dipped in any desired portion of the band by adjusting the length of the matching stub on the base of the antenna.

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RESURRECTING A GRANDDADDY

Part One: Granddaddy

A page in an old notebook, with a couple of circuits and the words "Crystadin" and "Losev," brought a few memories and forced me to plug in a soldering iron and run a few experiments.

Time–middle 1920's; Place–Moscow, Russia; Time of the day–just after midnight; Picture–15 year old ham (later K6BIJ), sleepy, but determined, trying to adjust *two* catwhiskers on *two* crystals at the same time, while listening to weird sounds emanating from *two* earphones.

This was "Crystadin," a circuit introduced by a Russian ham Losev, a "temporary" invention – something to get by until the industry (in ruins after the WW1 and the Civil War) started to produce tubes. Somehow the circuit was able to produce regeneration, and also worked as an rf amplifier[1], using "Zincite"[2] crystals and steel wire catwhiskers. Looks like it was one of the granddaddies of some semiconductor devices "invented" later.

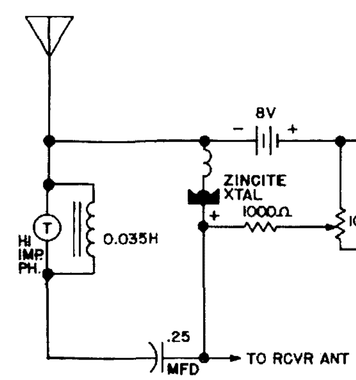

Fig. 1. RF amplifier.

I will not attempt to explain the theory of the Crystadin – I do not know how it works, but it looks like a mixture of regeneration and parametric amplification. The semiconductor junction, dc bias, and the pump freqency are all there.

Crystadin was used for reception of European BC stations; there was only one Russian BC station (in Moscow) at the time, and we hams had to wait till midnight for it to quit, before we could start fishing for DX. Very little was known at the time about short waves; there were no ham transmitters (no tubes), and a "ham" was just a guy that built his own crystal receivers, spent a lot of his spare time on the roof, and was generally responsible for the absence of what you place on the hook in a telephone booth.

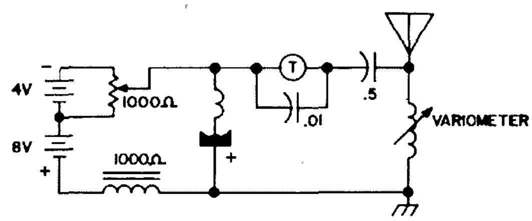

Fig. 2. Receiver

The poor granddaddy died at the age of three, killed by a "micro tube" (micro referring to a low filament current of 60 mA) that appeared on the market in the late 1920's. The death was very premature.

Passing (too briefly) through the regenerative circuits[3] – the tubes made possiblc a monstrosity called "superhet," the Supreme Ruler of the receiver world, still being worshipped by the hams and engineers alike. Like anything else, being worshipped, it did not improve any since its invention (only the components did), and is still a contraption to bury weak signals in the noise and hiss generated by it.

1. See "RF Q Multiplier," 73, May 1962, page 80.
2. Zincite–ZnO, a zinc ore (mineral), melted and cooled to produce a lump covered with red crystals.
3. See "Superhet or Regenerator," 73, March 1964, page 58.

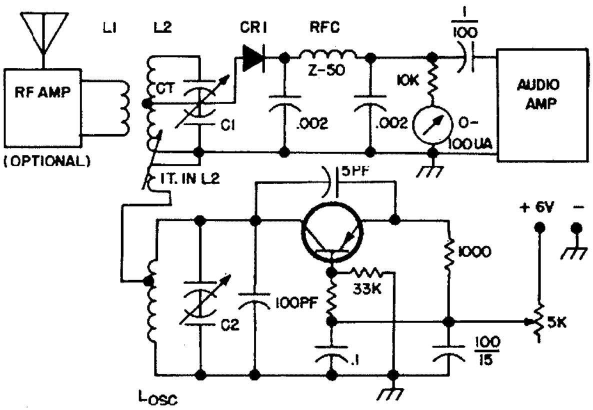

Fig. 3. Schematic.

Part Two: Resurrection

The circuit shown in Fig. 3 can be visualized as a superhet with local oscillator removed from the receiving frequency only just enough to produce an i-f that is, at the same time, your audio (this is true also in case of a regen, only there the oscillator and detector functions are performed by the same tube or a transistor). Let us compare a block diagram of Fig. 3 with that of a conventional six meter superhet. We can see that to produce the same gain, the audio section of the Fig. 3 must have as much gain as the two mixers, two i-f's, and the audio of the superhet *combined*. This means quite an audio amplifier, but it also means quite less

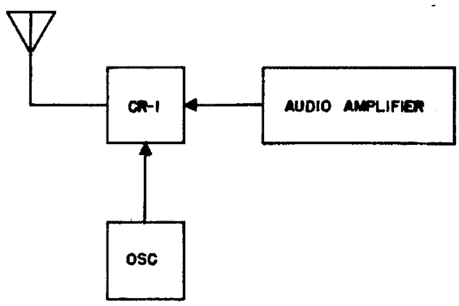

Fig. 4. Block diagram of receivers.

noise generated in the receiver because mixers are notorious noise generators and because transistors are much less noisy at lower frequencies than at high.

You probably saw in some manual that a certain transistor has a noise figure (nf) of let us say "4" at 200 MHz, but only "2" at 100 MHz, etc. In the audio range the nf is of course still lower. This, coupled with a complete absence of images, birdies, and all the other byproducts manufactured within any self-respecting superhet, explains the low internal noise of the Fig. 3 circuit.

Certain deficiencies of the K6BIJ engineering department, coupled with a complete inability to penetrate the semiconductor jungle existing in this country, and viewed through a large hole in the pocketbook – resulted in working, but far from perfect, audio amplifier. It consists of Fig. 1, WIDTY's article, March, 1967, in 73, followed by Fig. 14 (operated at 6 volts and

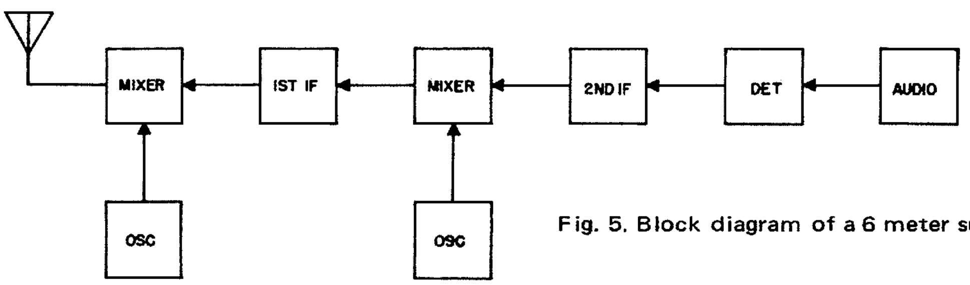

Fig. 5. Block diagram of a 6 meter superhet.

with the filter centered around 800 cycles), and followed by an existing amplifier designed for crystal microphone input and one watt output. Transistors were PNP units marked 033, and taken from IBM surplus boards (disregarding the "0" – if the number is less than 50 it is PNP, if over 50 it is NPN). Failure to produce a quiet audio amplifier naturally will defeat the purpose of the project; in this case I suggest that you temporarily retain the rf amplifier – it will be a step backward, but a much simpler audio unit will do.

Normally regenerative receivers are stable, selective and sensitive, but you can wreck all this if you overcouple them to the antenna or try to get more "gain" by using higher voltage and current through the regenerating tube or transistor. The "gain" should be in the audio amplifier. The ARC-5 receivers, that are supposed to be "as broad as a barn door," are broad only because they have practically no audio, and hams are trying to compensate for this by cranking up the rf i-f gain wide open. Result – the "barn door." I added two stages of audio (also transistor bfo) and am using it on 80 meters SSB and CW without any "barn door" effects.

Now comes CR-1; I connected twelve diodes of all kinds to a twelve position switch, and just tested them in the circuit. Some of the diodes were transistor base-emitter junctions. Those that did not work were replaced by other "unknowns," and so on. As a result it was found that 1N21 always performed fairly well, but some of the glass encapsulated catwhiskers from the IBM surplus boards outperformed the 1N21 quite a bit. Using an ohmmeter to choose the diodes resulted in a failure; my best diode has 30% reverse leakage, and the second best has practically none.

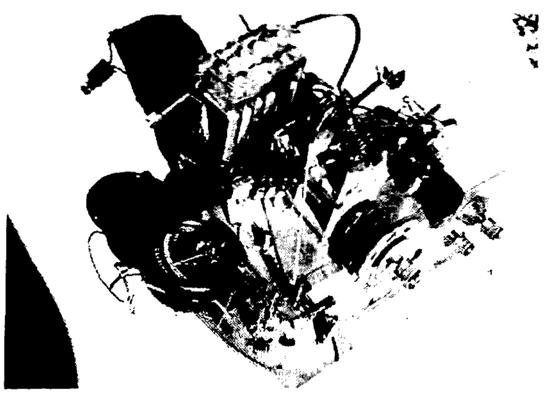

Photo of audio amplifier inside the chassis. The nicad battery pack at the rear of the unit supplies about 7.2V.

What takes place at the junction in CR-1? I do not know, but whatever it is, it makes possible a darn good receiver for really weak signals. Whether it is a regen, parametric amp, or a superhet with low internal noise, it *works*. And if someone will tell me that the three circuits are just variations of one and the same principle, I will not be surprised.

Further improvement can be made by using a vxo instead of a vfo (Fig. 49, page 21-A, 73, March, 1967; a search for a better diode should bring some results, and, of course, there is no limit in improving the audio system.

Variable condensers *must* be of the split-stator, insulated-rotor type, otherwise the noise produced by the rubbing contacts will split your eardrums. The meter shown in the

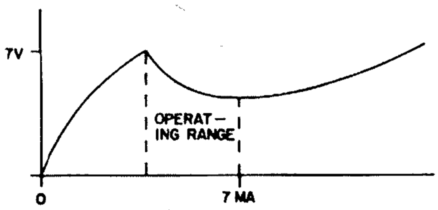

Fig. 6. Voltage/current in crystal in receiver. (see Fig. 2)

circuit is useful only as an indicator of oscillations in your oscillator circuit, and also for tracking (just tune the trimmer condensers and adjust the coils for maximum reading on the meter). Minimum voltage should be used on the oscillator just enough to start it.

The circuit outperformed on six meters a usual converter (rf FET 2N3819–mixer 2N3819–crystal oscillator–RCA SK 3006) followed by an average receiver; it had less internal noise; therefore, weak signals were received much better. It worked best on SSB and CW; AM was somewhat difficult to tune unless the station was fairly strong.

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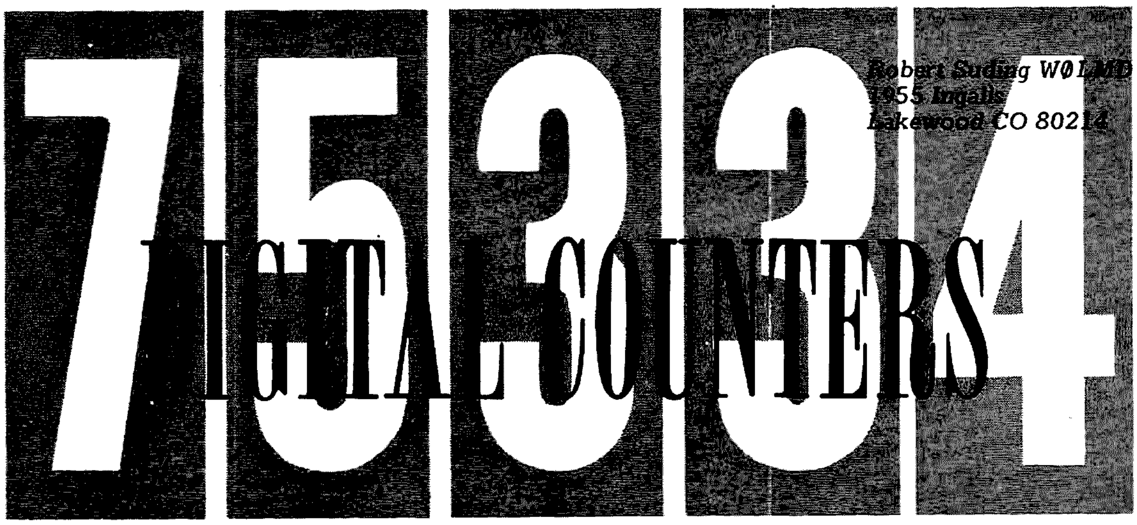


DIGITAL COUNTERS

Robert Suding W0LMD
1955 Ingalls
Lakewood CO 80214

"Your frequency is 3637.490 kHz, OM. Would you please move 10 Hz higher to get on the teletype auto-start frequency?"

You'll never hear this on the ham bands? Wait 'till you contact me!

Ever dream of building a receiver/transmitter, or maybe an rf signal generator that would give a digital readout of frequency to the nearest hertz? Well, just you read this article about the digital indicators, and put a little tin on your dream rig.

In building such a project as this, there are 4 main considerations that must be kept in mind:

1) Usages, actual and possible.
2) Reliability (bulb burnout, etc.).
3) Component availability (readout Indicators, transistors, integrated circuits, resistors).
4) How complex; number of parts, amount of wiring (transistors vs integrated circuits).

Having come this far, I now wish to show you the different ways you can get a 0-9 number, then discuss various driver circuits to light up your chosen indicator.

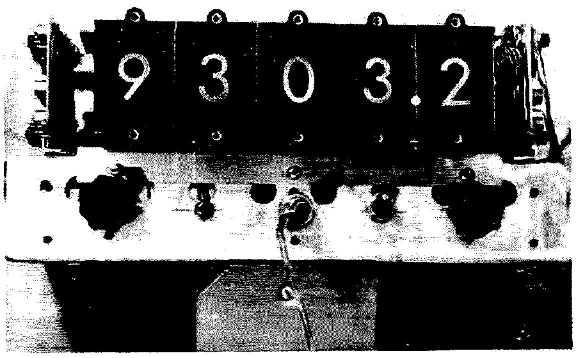
Numbered Light Bulbs

The simplest of all digital displays would be those of either Fig. 1a or 1b. Fig. 1a is merely a piece of clear plastic painted black on the front except where the number is. Lamps are placed behind each number, and shielded from showing through to the adjacent number.

Fig. 1b shows a similar method, only the light bulbs were encapsulated in plastic and little plastic letters were glued over the top of the appropriate bulb. Other arrangements, such as bulbs in a circle, etc., are also a possibility in this general type.

Advantages: Low cost—only the ten bulbs and a little plastic need be bought. Simplicity.

Disadvantages: Relatively short bulb life; small image, necessitating close reading; Out of line reading of long numbers, making the reading slower.



Front view of my digital frequency counter with a range of 50 Hz to 100 kHz and beyond, with a readout of 1/10 of a cycle. Projected image type of readouts are shown, driven by 5 digital decoder #2's.

Light Bar Matrix

Fig. 1c shows a system used by the Simpson III digital voltmeter and others, which presents several advantages while adding a few disadvantages too.

Seven lights are placed so as to form 10 distinct numbers by lighting up various combinations of light bars. To get a "1", bar

C & F are lit; "2" has bar A, C, D, E, & G lit to give 2; "3" has bar A, C, D, E, F, & G lit to give 3; "4" has bar B, C, D, F, & G lit to give 4; '5" has bar A, B, D, F, & G lit to give 5; "6" has bar A, B, D, E, F, & G lit to give 6; "7' has bar A, C, & F lit to give 7; "8" has all bars lit; "9" has all bars lit except E to give 9; "0" has all bars lit except D to give 0.

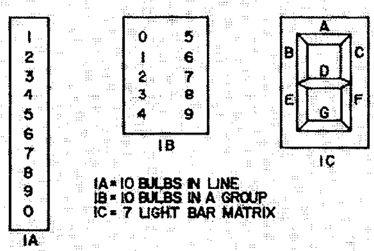


Fig. 1. 1a) 10 bulbs in line; 1b) 10 bulbs in a group; 1c) 7 light bar matrix.

These lights may take a number of forms. They may be a piece of plastic backlighted to give a bar on the front. Another possibility is to use long lamps similar to those used in car dome lamps, only with low amperage. Even NE-2 neon bulbs may be used, along with high voltage switching transistors.

Advantages: Larger Number
Brighter number
Inline reading of long numbers
Cheaply made in comparison with commercially available readouts.

Disadvantages: Proper lamps difficult to find.
More difficult assembly as compared to simple numbered lights.
Brightness varies according to number of bulbs lit.
More current is drawn due to a number of lamps being lit.
Electronic driver circuit is more complex, though not much more expensive.

Edge Lighted

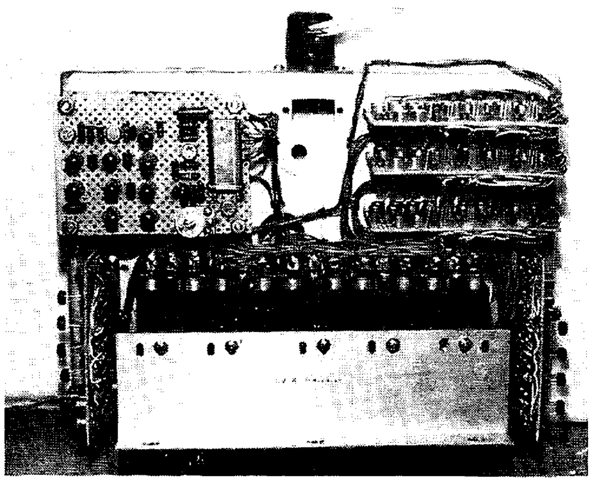
Some manufacturers have produced digital readouts which consist of 10 concentrically placed pieces of plastic, each with a number placed on it which is edge lighted to show the desired number. An example of this type is the readout sold by Radio Shack Corp. for $9.95.

Advantages: Very compact
Well formed number
Inline reading of long numbers.

Disadvantages: Dimmest of all displays.
Small angle of viewability.

Projected Image

This system consists of 12 light bulbs, 0-9 and + and -, which are projected on the back of a ground glass screen. Various bulbs may be used to achieve different levels of illumination. A #44 bulb will give the most brilliant display, but it requires a rather high current from the switching transistor, 250 mA. On the other hand, an 1819 bulb @ 40 mA is rather easy on the transistor, but is quite dim, having a relative character brightness of 15 as opposed to 145 for the #44 bulb.



Top view, showing how I mount the various decoders. Section at back left is the crystal oscillator and gating circuitry. Not shown, but beneath this section are the 24 flip-flops in the ' divide by one million" section.

By reducing the voltage 10%, bulb life of 3000 and 1000 hours, respectively, will be increased 5 times, for 15,000 hours for the #44. Relative brightness will be cut in about half. The popular #47 at 150 mA will perform at about ½ the brilliance of the #44.

Cost of these units varies considerably. New ones run in the neighborhood of $30

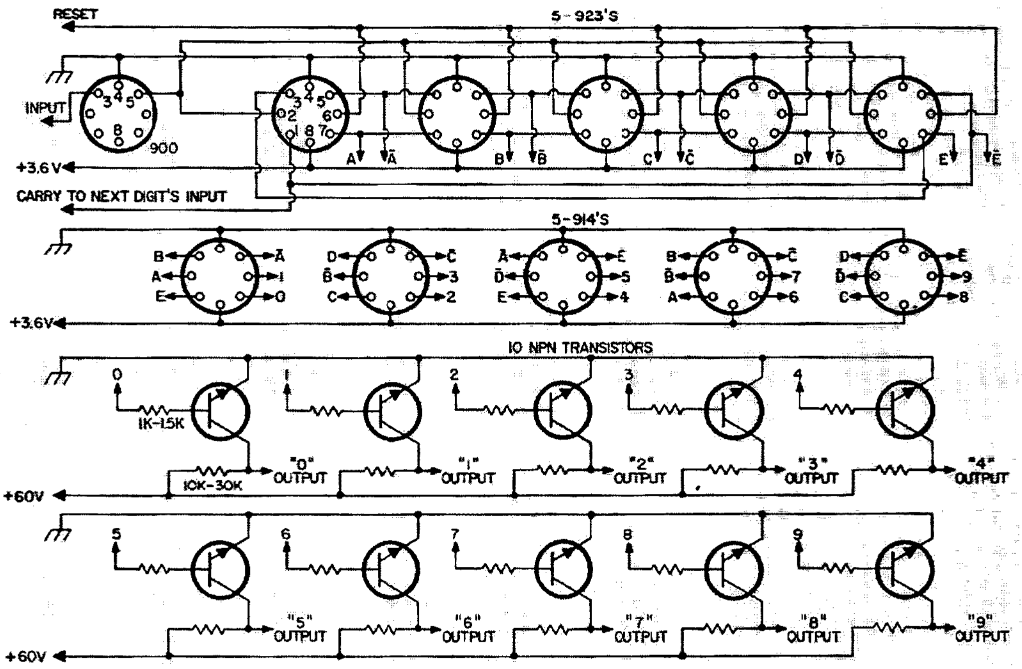


Fig. 2. Digital decoder #1. Reset to 0 by momentarily placing +3.6 v on reset line. All resistors of a similar function are the same value.

each. However, various surplus stores do have them at prices from $6 to $10, the former being about the most that I would pay. At that price, a bank of 5, as I myself use, makes a very attractive display unit for $30.

Advantages: Nice looking image
Ease of mounting
Simple and cheaper driver circuits
Low cost (if surplus)
Inline reading of long numbers

Disadvantages: Bulb burnout
Bulky

Nixie Tubes

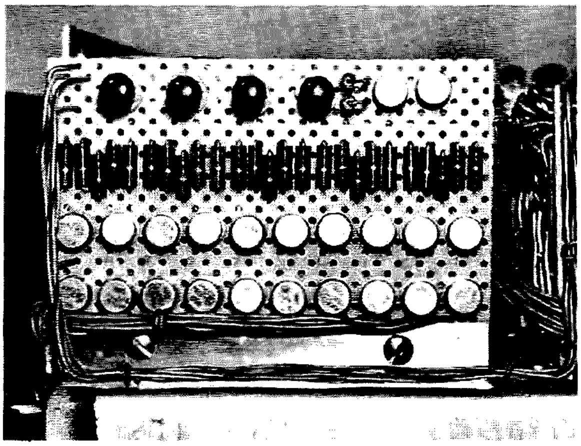
These readouts are a gas filled, cold cathode type tube. They are somewhat similar in basic idea to a vr tube or a neon tube, only they display a given number depending on which of a number of cathodes is hooked up to negative voltage. When this happens, the gas around this element ionizes and glows. Prices on these devices vary according to size and construction. Units of interest to amateurs run from $8 to $30 in price, the $8 one looking like a miniature tube, giving numbers .6" high. These units require special sockets running about $1 apiece. I have seen Nixie tubes on the surplus market as low as $3 apiece. For information, write to: Burroughs Corp., Electronics Components Division, Plainfield NJ 07061.

Advantages: Very long life (200,000 hours)
Bright and easy to read
Compact
Wide angle of viewability
Simple driver circuit
Different sizes available

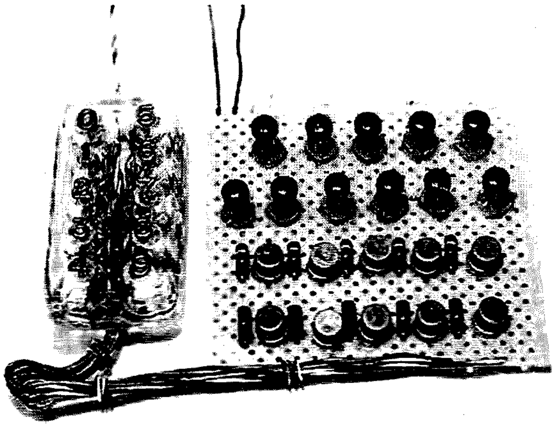
Disadvantages:
Require power supply of about 200V
Special circuit needed for dimming
(I don't like their red colored number.)

Pixie Tubes

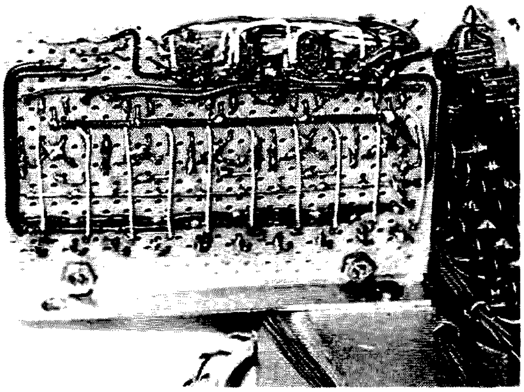
These are units similar to the Nixie, but instead of seeing a relatively large number lit up, a small number is visible through a perforated plate above the lit-up cathode. The advantage of these units over the more common Nixie lies in the fact that they are much cheaper, costing only $5 new, and much less surplus. The main disadvantage is that the number images are so small, about 3/16", that it is very difficult to read them at a distance greater than 6 feet. Besides this,



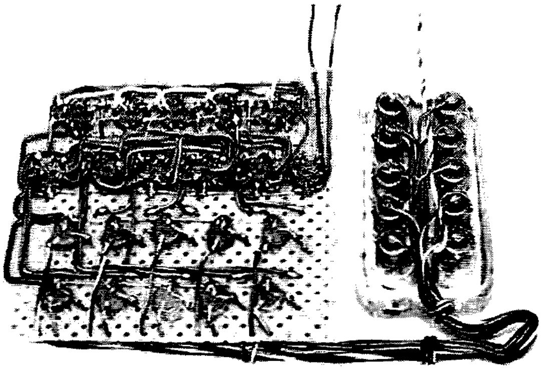
Top view of digital decoder #2. At the top are the IC and 2 transistor gates. In the middle are the other gates. At the bottom are the drivers.



Top view of digital decoder #1. At the top are the 5 flip-flops. The 2nd row has the 900 driver at the left, and the other 5 IC's are the 914's. The other transistors are the drivers. At the left is a digital display which consists of 10—#49 light bulbs encapsulated in plastic.



Bottom view of digital decoder #2.



Bottom view of #5.

a long number would be read slower due to the individual digits out of line.

High Vacuum Readouts

Though similar to a Nixie, these are tubes which project an image quite similar to the way a CRT works. For more information, write to: Industrial Electronic Engineers, Inc., 7720 Lemona Ave., Van Nuys CA 91405. This company can also give you more information on the projected image type readouts, which they make.

Advantages:
- Long life if brilliance reduced
- Other advantages of the Nixie
- Can be dimmed by a simple circuit

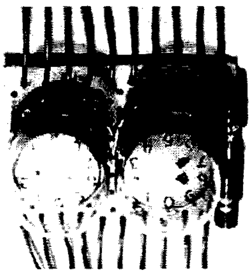
Disadvantages:
- Hv supply of 1-3 kV required, plus 1.1V filament supply
- Smaller image and slightly higher cost than the Nixie.

Digital Drivers

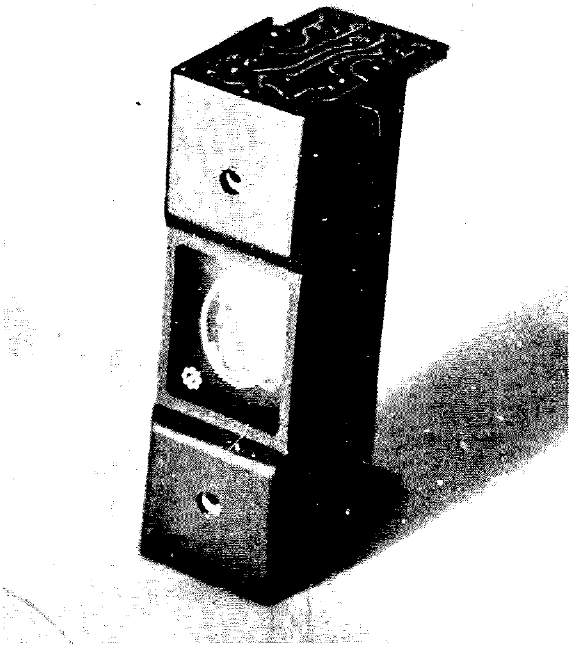
So that you can arrive at the desired digital signal to your selected type of readout, you have 3 items to consider now.

First, you must have a set of flip-flops which will have 10 different states, and then start over. There are a number of different ways to hook up 4-6 flip-flops and additional gating transistors to achieve this. In this article, I have selected 2 ways as being the simplest to work with.

Secondly, you must select the outputs of the flip-flops and steer the proper voltage to the driver stage, which comprises the third part of the whole digital decoder.



Two Pixier indicators, mounted on some keyboard.



An edgelit indicator showing internal construction.

Digital Decoder #1

This decoder needs 31-41 parts: 5–JK flip-flops (Fairchild 923 IC); 1–Driver/Buffer (Fairchild 900 IC); 5–Dual 2 input gates (Fairchild 914 IC); 10–1K-1.5K ½ watt resistors; 10–10K-30K ½ watt resistors (only if Nixie/Pixies used); 10–Driver xstrs (Surplus NPN, or, if Nixie/Pixie used, hv xstr as Fairchild 2N3568)

Cost: $20 if you use Nixie/Pixies and buy the resistors; $12 is you use lamps and have the resistors.

Wiring time: about 6 hours from start to finish.

To build this circuit, a great deal of care is necessary to avoid errors. The way that I wire them is to put all of the ICs in the order shown in the diagram, then wiring the common pins, 4, 8, and 6 of the 923's. Next, wire the common pins of the driver and gating transistors and ICs. After this, put in the resistors and complete the wiring except the wiring of the 914 decoding gates which is the last to be wired and the most prone to error.

As you can see in the parts list, there are a few different ways to build this decoder. If you plan on using the Nixie/Pixie type of indicator, then you will need to use such transistors as the Fairchild 2N3568 or others with a 60V or more collector-to-emitter voltage rating. The 60V line and 10 resistors to the driver transistors is only necessary when Nixie/Pixies are used also. **Fig. 3a** shows how to hook up lamps to the decoder, and **3b** shows how to hook up Nixie/Pixies.

Digital Decoder #2

This is the unit which I use in my present digital counter. It has only 4 ICs, so cuts down on the cost of the unit, but uses 22 NPN computer transistors, which, while cutting down on the cost, adds to the complexity.

Parts used are as follows: 4–JK flip-flops (Fairchild 923 IC); 22–NPN switching transistors (Surplus computer); 2–2.7K ½ watt resistors; 5–470-680Ω ½ watt resistors; 10–4.7K-6.8K ½ watt resistors; 10–1K-2K ½ watt resistors.

Cost: Well under $10.

Wiring time: About 6 hours.

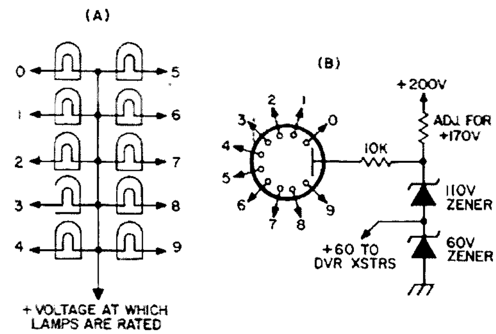


Fig. 3. 3a) How to hook up lamps to the decoder; 3b) How to hook up Nixie/Pixies.

As you can see, there is a definite cost advantage to decoder #2, if you can come by the transistors and resistors cheaply. I find the wiring of decoder #2 easier, due to less wires in the decoder, which is the most confusing part. Should you desire to use decoder #2 with Nixie/Pixie readouts, then change the driver transistors to hv types, and add a 10–30 kΩ resistor to each driver's

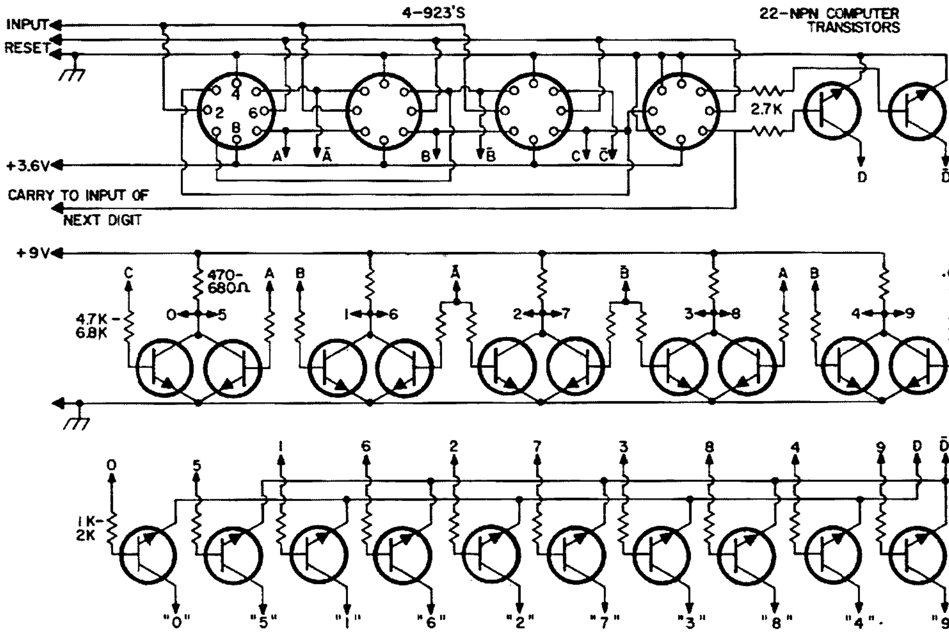


Fig. 4. Digital decoder #2. All resistors of a similar function are the same value. To reset to 0, place +3.6 v on reset line momentarily.

RESET TO ZERO BY MOMENTARILY PLACING 3.6V ON RESET LINE.
ALL RESISTORS OF A SIMILAR FUNCTION ARE THE SAME VALUE.

collector from a +60V source, as in decoder #1. Please note on the decoder #2 diagram, **Fig. 4**, that the outputs are not in numerical order. This is due to the fact that the ICs are in a biquinary count configuration, which means that they count to 5 twice to reach 10, then start over.

Digital Decoder #3

This particular unit is made up of either of the two preceding decoders plus a diode

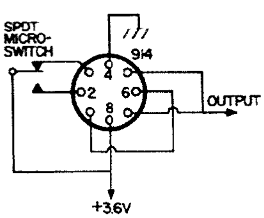


Fig. 5. A simple count checker.

matrix to drive the 7 light bars. As it is rather involved, I am not including it here, but those interested may obtain the schematic by sending me a SASE. The cost will approach $15 to $25, depending on parts availability, and the construction time will be about 10 or more hours.

Count Checker

A simple count checker which can be used to see that everything is counting correctly is shown in **Fig. 5**. Before you hook up the counter to read a multidigit number, make sure you have each digit counting correctly!

Improved Input Sensitivity

Fig. 6 shows the addition of an emitter follower to my original input circuit; this considerably improves the low frequency performance.
mance.

Digital Frequency Divider

As many have mentioned to me regarding the binary counter, it would be a shame to depend on the 60 Hz line frequency for a timing standard for such an accurate instrument as a digital counter. Therefore, I am now using a 100 kHz crystal as the standard. **Fig. 7** shows that I am using one of Jim Fisk's little crystal circuits into a 914 monostable pulse shaper. This in turn drives 24

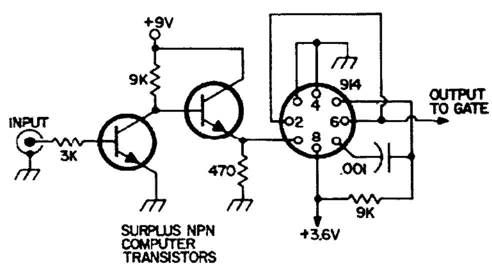


Fig. 6. Addition of an emitter follower to original input circuit of the binary counter.

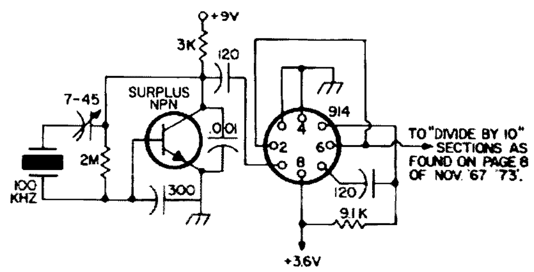
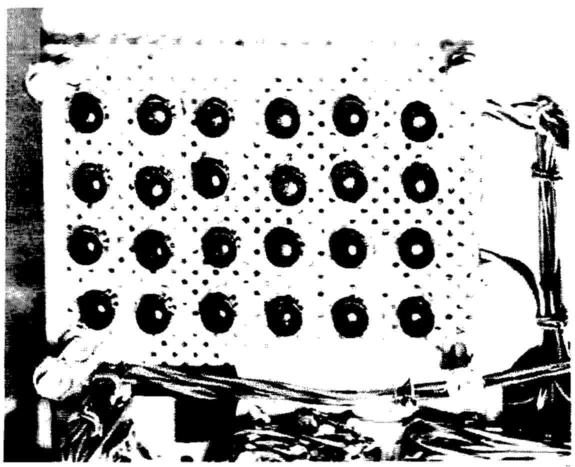


Fig. 7.

923 flip-flops hooked up as 6 "divide by 10" frequency dividers. This results in a "divide by one million," giving me a final output frequency of one hertz in ten seconds. Using this to trigger the count controller and gate, I take a count of all pulses in 10 seconds, thereby giving me an accuracy to one tenth of a hertz. The decimal point is inserted as hertz. The decimal point is inserted as shown in the picture. Various other frequencies are tapped off the divide by one million set of flip-flops to achieve other values of counts. This is described in my previous article.



Top view of the 24 923's in the ' divide by one million" section.

Flip-flops

A number of people have inquired about other types of ICs which might be used. Suppose that you wanted to count up higher in frequency. To do this, you would have to change the time constant of the input shaper by putting in a smaller condenser, and then using higher frequency ICs Say you wanted to read the output of a 7 MHz vfo. Simple. Use Fairchild 926s (freq. to 8 MHz as opposed to 2 MHz of the 923). Make a frequency divide section which will give you the desired accuracy, say 100 Hz. This will require a divide-by-1000 section, or 12 flip-flops. Now you can read out the frequency of that vfo to, say, 7034.8 Hz. How about 20, 15, and 10? Simple too! for 20 meters, add one more flip-flop to the 1000 divider to get 50 Hz. This way, you get double the count, or 14069.6 Hz. For 15, add a divide-by-3 to the divide-by-1000 to get 21,104.4 Hz. For 10 meters, add two divide-by-2 for a divide-by-4. . Exciting? Certainly is! Accurate? Just as accurate as when you zero that 100 kHz crystal with WWV. Of course you don't have to read out the whole number, but can read out the last 3 or 4 only, since you should know your frequency to within a megahertz. Where do you do from here? Well, I've given you some ideas on the fundamentals. The rest I leave to you.

. . .WØLMD

Bibliography

For those people who are interested in the theory behind digital readouts and decoders, I would like to recommend the following free literature.

Nixie/Pixie tubes: Bulletin 1104A
Bulletin 1095
#616E (General Catalog & Applications.

Write: Burroughs Corp., Electronic Components Div., Plainfield NJ 07061.

High Vacuum/Projected Image readouts: Request information from:

Industrial Electronic Engineers, Inc., 7720 Lemona Ave., Van Nuys CA 91405.

Fairchild IC's: Applications brief 36 on 9960 series
Circuit Notes RTL 1 through 5.
App-120/2, App-118/2 & SL-218

Write: Fairchild Semiconductor, 313 Fairchild Dr., Mountain View CA.

Fairchild parts and information: Request "Designing with Integrated Circuit Components"

Write: Hyer Electronics Co., Denver Technological Center, PO Box 22227, Denver CO 80222.

General Digital information:

Write: Interstate Electronics Corp. 707 E Vermont Ave., Anaheim CA–Request S-139A and Updates. Digital Equipt Corp., Technical Publications Dept., 146 Main St., Maynard MA 01754–Request "Logic Handbook."

IDENTIFYING SURPLUS ELECTRONIC EQUIPMENT

by Bill Welsh W6DDB

Most hams are vaguely familiar with the two- and three-letter prefixes used on military electronic equipment. The JAN (Joint Army-Navy) designations have been expanded upon and superseded by the Joint Electronics Type Designation System (JETDS). JETDS designations apply to all Air Force, Army, Marine, and Navy electrical/electronic equipment.

The following tables provide information which permits quick classification of any military electronic item which bears the customary letter identification. Table I shows the three-letter classifications used with the complete systems, sets, and groups. Table II shows one and two-letter classifications used with units and components which are basically parts of the systems, sets, and groups detailed in Table I.

The information shown in Tables I and II is primarily extracted from MIL-STD-196B (Joint Electronics Type Designation System), dated 7 April 1965.

Table I. System/Set/Group Classifications

First Letter (Installation)		Second Letter (Equipment Type)		Third Letter (Equipment Purpose)	
A	Piloted Aircraft	A	Invisible Light, or Heat Radiation	A	Auxiliary Assembly (Not Complete Operable Sets)
B	Submarine or	B	Pigeon (Obsolete)	B	Bombing
C	Air Transportable (Obsolete)	C	Carrier	C	Communications (Receiving and Transmitting)
D	Pilotless Carrier	D	Radiac	D	Direction Finder, Reconnaissance and/or Surveillance
		E	Nupac	E	Ejection and/or Release
F	Ground-Fixed	F	Photographic (Canadian only)		
G	Ground-General Use	G	Telegraph or Teletype	G	Fire Control or Searchlight Direction
				H	Recording and/or Reproducing (Graphic, Meteorological, or Sound)
		I	Interphone or Public Address		
		J	Electromechanical or Inertial-Wire Covered		
K	Amphibious	K	Telemetering	K	Computing
		L	Countermeasure	L	Searchlight Control (Obsolete - use G)
M	Ground-Mobile	M	Meteorological	M	Maintenance and/or Test Assemblies, including tools
		N	Sound in Air	N	Navigation - including Altimeter, Beacon, Compass, Depth Sounder, Landing & Approach, and Racon
P	Portable	P	Radar	P	Reproducing (Obsolete - Use H)
		Q	Underwater Sound and Sonar	Q	Special or Combination of Purposes
		R	Radio	R	Receiving-Passive Detection
S	Water-Surface	S	Special Types, such as Magnetic or Combination of Types	S	Active Detection and/or Range and Bearing
T	Ground-Transportable	T	Telephone (Wire)	T	Transmitting
U	General Utility				
V	Ground-Vehicular	V	Visual and Visibile Light		
W	Water-Surface and Underwater Combinations	W	Armament, Not Otherwise Covered	W	Automatic Flight or Remote Control
		X	Facsimile or Television	X	Identification or Recognition
		Y	Data Processing		

As an example, the AN/APS-80A(V) is (first letter A) installed in a piloted aircraft, (second letter P) is a Radar type equipment, (third letter S) is used for search purposes, is Model number 80, is modification A, and consists of a variable grouping. Model numbers and modification letters are used in sequence. The T, V, X, Y, and Z suffixes respectively indicate Training, Variable Grouping, Voltage Change, Phase Change, and Frequency Change in the basic equipment.

The two-letter unit/component identification is commonly identified to the system/set it is designed for by suffixing a slant bar and the identification of the system or set. As an example, the AM-3474/APS-80A(V) is a synchro signal amplifier designed as part of the APS-80A(V) airborne search radar system.

Identification	Unit or Component	Typical Description
AB	Antenna Support	Antenna mounts, mast base, mast section, tower, etc.
AM	Amplifier	Audio, electronic control, frequency, interphone, power, radio, video, etc.
AS	Simple or Complex Antenna	Array, dipole, loop, mast head, parabolic, reflector, telescopic, etc.
BA	Primary Battery	Non-rechargeable battery, batter pack, etc.
BB	Secondary Battery	Rechargeable battery, storage battery, etc.
BZ	Audible Signal Device	Buzzer, gong, horn, etc.
C	Control	Control box, remote tuning control, etc.

Table II. One- and Two-Letter Unit/Component Classifications

CA	Sonar Commutator Assembly	All types
CB	Capacitor Bank	Power Supply, etc.
CG	RF Cable Assembly	RF cable, waveguide, transmission line, etc., with connectors
CH	Drawer/Door Chasis	Framework which accepts (but does not include) plug-in modules. Circuitry and/or receptacles may be included. This is not a storage facility or blank chassis.
CK	Crystal Kit	Kit of crysals with holders
CM	Comparator	Compares two or more signals
CN	Compensator	Electrical and/or mechanical compensation, regulation, or attenuation
CP	Computer	Electronic and/or mechanical mathematical computing device
CR	Crystal	Crystal, in a crystal holder
CU	Coupler	Impedance matching device, directional coupler, etc.
CV	Converter	Electronic device which changes phase, amplitude, or frequency; or changes from one medium to another
CW	Cover	Bag, cap, cover, nacelle, radome, roll, etc.
CX	Non-RF Cable Assembly	Cable with terminals, test leads, or composite cable with non-RF and RF conductors
CY	Case or cabinet	Rigid or semi-rigid structure for enclosing or carrying equipment
D	Dispenser	Bomblet, chaff, flare, leaflet, napalm, etc.
DA	Electrical Dummy Load	RF or non-RF test load
DT	Detecting Head	Hydrophone, magnetic pickup, search coil, etc. (see RF)
DY	Dynamotor	Power supply
E	Hoise	Sonar hoist assembly, etc.
F	Filter	Bandpass, noise, telephone, wavetrap, etc.
FN	Furniture	Chair, desk, table, etc.
FR	Frequency Measuring Device	Frequency meter, tuned cavity, etc.
G	Power Generator	Electrical power generator without prime mover (see PD and PU)
GO	Goniometer	All types
GP	*Ground Rod*	*Ground rod, stake, etc.*
H	Handset, Headset, or Chestset	Includes earphone
HC	Crystal Holder	Crystal holder, less the crystal
HO	Environmental Apparatus	Cooling, dehumidifying, heating, pressure, vacuum, etc.
ID	Non-CRT Type Indicator	Calibrated dial, calbirated meter, indicating light, etc.
IL	Insulator	Feedthrough, standoff, strain, etc.
IM	Intensity Measuring Device	Field intensity meter, noise meter, slotted line, SWR gear, etc.
IP	CRT-Type Indicator	Azimuth, elevation, panoramic, etc.
J	Junction Device	Jack box, junction box, terminal box, etc.
KY	Keyer	Coder, electrical keyer, electronic keyer, interrupter, mechanical keyer, etc.
LC	Line Construction Tool	Cable plow, etc.
LS	Loudspeaker	Intercommunication station, enclosed loudspeaker, etc.M
MA	Magazine	Magnetic tape, magnetic wire, etc.
MO	Modulator, Demodulator, or Discriminator	Device to vary amplitude, frequency, or phase
ME	Meter	Multimeter, power meter, VOM, VTVM, etc.
MF	Magnet or Magentic Field Generator	Electromagnet, magnetic tape or wire eraser, permanent magnetc, etc.
M1	Microphone	Hand, radio, telephone, throat, etc.
MK	Miscellaneous Kit	Maintenance, modification, etc., except crystal (CK) and tool (TK) kits.
ML	Meteorological Device	Barometer, hygrometer, scale, thermometer, etc.
MT	Mounting	Frame, mount, rack, stand, etc.
MU	Memory Unit	All types
MX	Miscellaneous Equipment	Otherwise unclassified equipment, including subassemblies. Use a definitive indicator instead of MX, if possible.
O	Oscillator	Blocking, master, multivibrator, etc. (See SG for test oscillator)
OA*	Miscellaneous Group	Otherwise unclassified group. Use a definitive indicator instead of OA, if possible.
OB*	Multiplexer and/or Demultiplexer Group	All types and composites
OC	Oceanographic Device	Bathythermograph, etc.
OD*	Indicator Group	All types
OE*	Antenna Group	All types
OF*	Adapter Group	All types
OG*	Amplifier Group	All types
OH*	Simulator Group	All types
OJ*	Console or Console Group	All types
OK*	Control Group	All types
OL*	Data Analysis or Data Processing Group	All types
OM*	Modulator and/or	All types and components
ON*	Interconnecting Group	All types
OP*	Power Supply Group	All types
OQ*	Test Set Group	All types
OR*	Receiver Group	All types
OS	Oscilloscope	Scopes for general test use
OT*	Transmitter Group	All types
OU*	Converter Group	All types
OV*	Generator Group	All types except power-generation
OW*	Terminal Group	Radio, telegraph, telephone, etc.
OX*	Coder, Decoder, Interrogator, or Transponder Group	All types and composites
OY*	Radar Set Group	Where applicable, use a more definitive indicator such as OE, OR, OT, etc.
OZ*	Radio Set Group	Where applicable, use a more definitive indicator such as OE, OR, OT, etc.
PD	Prime Driver	Diesel motor, electric motor, gasoline engine, synchro, etc.
PF	Pole Fitting	Cable hanger, clamp, protector, etc.
PG	Pigeon Article (Obsolete)	Container, loft, vest, etc.
PH	Photographic Article (Obsolete)	Camera, projector, sensitometer, etc.
PL	Plug-in Module	Where applicable, use a more definitive indicator such as AM, R, T, etc.
PP	Power Supply	Non-rotating type such as vibrator pack rectifier, thermoelectric, etc.
PT	Plotting Equipment	Rotating power equipment other than dynamotor or motor generator
R	Receiver	All types except telephone
RC	Reel	All types (See RL)
RD	Recorder-Reproducer	Disc, facsimile, film, graphic, magnetic, mechanical, sound, tape, wire, etc.
RE	Relay Assembly	Electrical, electronic, etc.
RF	Radio Frequency Component	Composite component of an RF circuit. Where applicable, use a more definitive indicator.
RG	RF Bulk Cable	RF cable, transmission line, waveguide, etc., without terminals
RL	Reeling Machine	Mechanism for dispensing and rewinding antenna wire, field wire, recording wire, recording tape, etc.
RO	Recorder	Disc, facsimile, film, graphic, magnetic, mechanical, sound, tape, wire, etc.
RP	Reproducer	Disc, facsimile, film, graphic, magnetic, mechanical, sound, tape, wire, etc.
RR	Reflector	Confusion, target, etc., but not antenna reflector (See AS)
RT	Receiver-Transmitter	*Composite radio/radar receiver and* transmitter
S	Shelter	House, tent, etc.
SA	Switching Device	Impact, manual, motor-driven, pressure, etc.
SB	Switchboard	Fire control, panel,power, telephone, etc.
SG	Signal Generator	Noise generator, test oscillator, etc. (See O)
SM	Simulator	Aircraft, flight, signal, target, etc.
SN	Synchronizer	Device to coordinate two or more functions
ST	Strap	Harness, etc.
SU	Optical Device	Boresighting scope, periscope, pro*jector, telescope, etc.*
T	Transmitter	All types, except tleephone
TA	Telephone Apparatus	Miscellaneous telephone equipment
TB	Towed Body	Buoy, fish, paravane, target, etc.
TC	Towed Cable	Articulatec towing strut, faired cable, etc.
TD	Timing Device	Electronic gate, electronic timer, mechanical timer, multiplexer, range device, etc.
TF	Transformer	Separate identification only when used as a separate item
TG	Positioning Device	Tilt and/or train assembly
TH	Telegraph Apparatus	Miscellaneous telegraph equipment
TK	Tool Kit	Miscellaneous tool assemblies
TL	Tool	All types, except line construction (LC)
TN	Tuning Unit	Antenna, receiver, transmitter, etc.
TR	Transducer	Magnetic head, phono pickup, sonar transducer, vibration pickup, etc. (See H, LS, and M)
TS	Test Set	Test end measurement equipment not otherwise categorized
TT	Teletype or Facsimile	Miscellaneous facsimile, tape, teletype and similar equipment
TV	Tube Tester	All types
TW	Tape and Recording Wire	Electrical tape, insulating tape, recording tape, splicing tape, recording wire, etc.
U	Audio or Power Connector	Adapter, plug, receptacle, socket, tee, union, etc.
UG	RF Connector	Adapter, choke coupling, elbow, flange, plug, socket, tee, union, etc.
V	Vehicle	Cart, dolly, trailer, truck, etc.
VS	Visual Signalling Equipment	Flag set, serial panel, signal lamp, etc.
WD	Two-Conductor Cable	Non-RF, cable and cordage in bulk (See RG)
WF	Four-Conductor Cable	Non-RF, cable and cordage in bulk (See RG)
WM	Multiple-Conductor Cable	Non-RF, cable and cordage in bulk (See RG)
WS	Single-Conductor Cable	Non-RF, cable and cordage in bulk (See RG)
WT	Three-Conductor Cable	Non-RF, cable and cordage in bulk (See RG)
ZM	Impedance Measurement Device	Measures C, L, Q, R, power factor, etc.

*Represents a collection of items which are part of (or used with) a system/set or a series of system/sets.

The two-letter unit/component identification is commonly identified to the system/set it is designed for by suffixing a slant bar and the identification of the system or set. As an example, the AM-3474/APS-80A(V) is a synchro signal amplifier designed as part of the APS-80A(V) airborne search radar system.

The Horizontal Output Linear

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Many amateurs who are not fortunate enough to be wealthy will find this article of interest. Many of us desire higher power so as to cut through the QRM present on 20 meters but do not have the spare cash to purchase exotic tubes such as the 4-1000, 4-400, etc.

It has long been known that it is possible to parallel various tubes such as the 807 or 1625 and create an operable linear. This linear is merely a modern version of this paralleling circuit which works well and is simple and inexpensive to construct. In addition to this, the unit exhibits no instability.

With a well stocked junkbox, the average amateur should be able to construct this amplifier for under $20.

I concentrated the design of the linear shown in Fig. 1 about the 6JE6 tube, which is commonly used as the horizontal output tube of many of the present color television receivers on the market. The specifications of the 6JE6 from tube manuals do not show it as a powerhouse. When looking at the size of the plate on the 6JE6, it becomes apparent that it must be capable of a good amount of dissipation. Also, as a pentode, it would have the necessary isolation between cathode and plate that is required for unneutralized operation. We are grounding all the grids, so essentially the tubes are working as triodes for this application.

Six of the 6JE6s are paralleled in the final. All of the grids are grounded directly to the shell of the 9-pin socket. It is essential that these grids are grounded as close as possible to the shell or instability will result. Simply bend down the socket pins and solder them directly to the shell.

I attempted to operate the cathodes at ground potential; however, the resting current of the linear was in the neighborhood of 225 mA – which, of course, is excessive. The choke that isolated the cathodes from rf ground is wound on a half-inch piece of ceramic stock 4 in. long. Fill the entire length of this with 26 AWG enamel wire. It was necessary to bias the cathodes of these tubes to lower the resting current to 80 mA. This was done with the use of two 75Ω, 160W wirewound resistors in series with the cathode choke to ground.

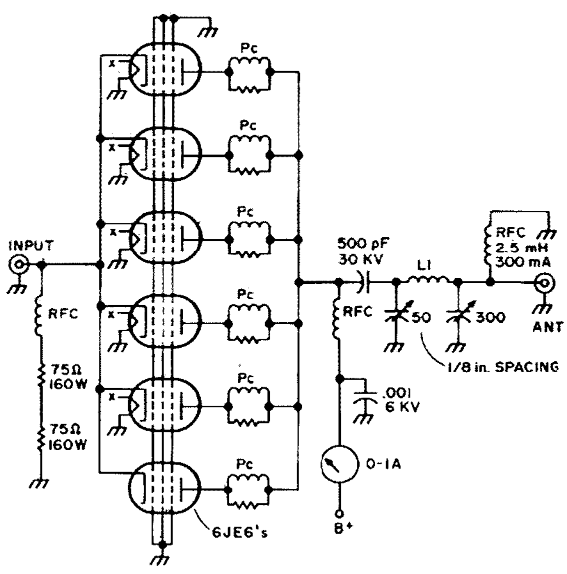


Fig. 1. Schematic diagram of the "horizontal-output" linear amplifier.

(These large resistors are only $2.50 each.)

At this point, you may think that it would be easier to bias the grids. I tried this but instability resulted. Also, it is easier to solder in two large resistors than build an entire bias supply. In operation, these two resistors run very cold even at 500 mA instantaneous current.

It was necessary to use parasitic chokes in the plate lead of each of the tubes. These are constructed from 5 turns of 14 AWG copper wire (½ in. diameter coil) around a 92Ω, 1W resistor. With these chokes in the circuit, there is no trace of parasitics.

The plate rf choke is also homebrew. In fact, it is identical to the cathode rf choke. This is mounted at a central point in the group of tubes and is bypassed to the chassis with a 0.001 μF, 6 kV disk ceramic capacitor. The dc blocking capacitor (rf coupling) is merely a TV "doorknob" capacitor rated at 500 pF, 30 kV.

The final tank coil is constructed from 5 turns of ¼ in. copper tubing, 2½ in. in diameter. This is resonated in a pi-network configuration with a 50 pF variable for resonance and a 300 pF broadcast variable for antenna loading. Make sure that the 2.5 mH choke going from the output lead to ground is in the circuit or a brilliant display of fireworks will occur in the test stages of this rig.

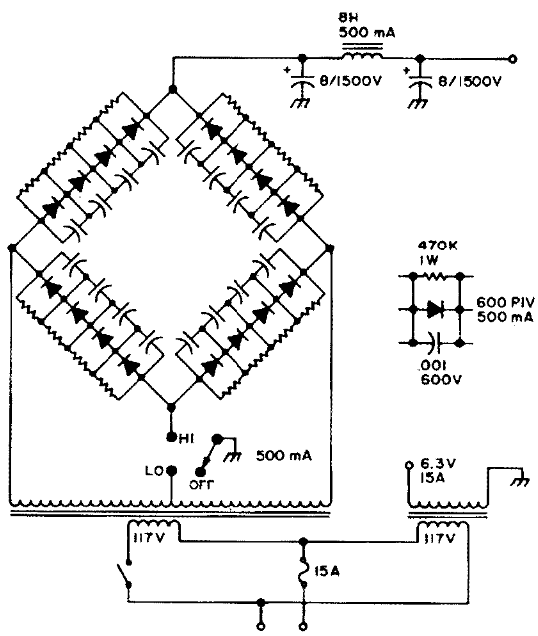


Fig. 2. Linear power supply.

The power supply (Fig. 2) uses a 1 kV secondary, 500 mA power transformer. You probably could use two identical TV power transformers phased in parallel to achieve the necessary current capability. We were fortunate enough to have this transformer lying about from a military regulated supply. With 1 kV going into the diode rectifier bridge, the output voltage will fall at approximately 1.3 kV with 80 mA of resting current and will drop to 1 kV when the linear is drawing 500 mA. Of course this represents 500W dc input, or 1 kW sideband power.

The bridge consists of bargain silicon diodes which are rated at 600 PIV, 500 mA each. In each leg of the bridge, four of these diodes are in series and equalized, which gives each leg a 2.4 kV rating. Each diode is voltage equalized and protected from surge and transient spikes by paralleling 470 kΩ, 1 watt resistors and .001 μF, 600V disk ceramic capacitors about the diode. The high voltage is activated by grounding the negative side of the bridge with a toggle switch. Filtering is achieved through two 8 μF, 1.5 kV oil-filled capacitors and an 8H, 500 mA filter choke.

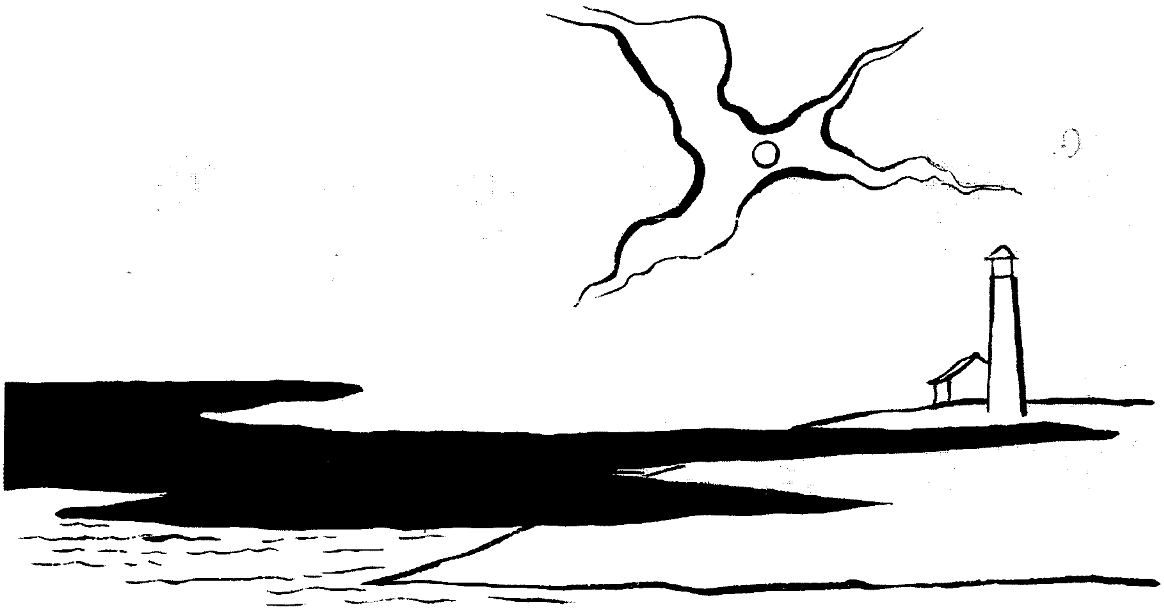
It may sound surprising but each of the 6JE6s draws 2.5A of filament current at 6.3V ac. When you consider that there are 6 of these, it takes 15A at 6.3V to keep these bottles heated. Make sure that the filament transformer is adequate to handle this current.

When tuning up the linear, apply drive to the input and resonate it as with any final. There should be no current drawn above 80 mA with no drive applied. Do not hold the linear at 500 mA for any length of time as it will overheat the finals. The linear is designed for CW or sideband operation where the average will be much lower than 500W dc. Of course the rf peak will be 1 kW in this mode.

I have been driving this linear with a DX-35 in CW mode and have had fine reports with a clean signal. This indicates that 50W drive will excite the linear nicely.

The simplicity and performance of the linear will make it well worth the time and effort of construction.

. . . W2AOO ■



DX AMERICA FIRST

Rev. Robert O. Gardiner W6LZJ
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One of the real thrills offered to the licensed amateur radio operator is the opportunity to work DX. That thrill is trebled when the DXing is done from some exotic out-of-the-way place. Unfortunately, most of us have neither the time nor the money to travel extensively . . .crossing oceans to far-flung islands or dense jungles. We may never visit the other continents nor hope to ham from the moon. However, there is nothing to prevent any ham from sharing in the thrill of a DXpedition within reach of simple transportation, in short vacation periods, and best of all, within the range of the billfold.

The wife permitting, the rig usually accompanies the family on every summer vacation. Installing the antenna and rig is as important as setting up the tent and preparing the first meal. The working of DX is fairly simple if the equipment includes the low frequencies. If you have never taken 6 and 2 meter equipment as your only station on a DXpedition you have missed one of the most exciting and interesting pleasures in all of ham radio.

Because of the short distances normally covered by VHF rigs, a good antenna is recommended. On the other hand, the smaller dimensions make this an easier antenna to pack along with all the other gear. Having decided what is to go, it is well to talk over with the rest of the family where the vacation is to be spent. If you are fortunate enough to live near a large lake or on either coast, an island makes an ideal hideout for the family and for hamming.

Recently, we made such a decision; and since we lived in New England, we decided to visit the island of Matinicus, 25 miles off the coast of Rockland (Maine). The old Merc was laden with clothes, the Clegg Zeus, Interceptor, a borrowed 40 ft mast, miles of stranded aluminum guy wire and coax, a CDR rotor, all the tools I could pack, and a 1.25 kW alternator manufactured under the name of Zeus. We had written ahead to the skipper of the *Mary A* making reservations for the 7:45 a.m. departure on August 1.

On the ferry next morning, I heaved a real sigh of pleasure when I noted all our things safely loaded on deck. Paint cans, a

live chicken or two, and tons of fresh foods were stacked between piles of building materials, plumbing supplies, and the raw materials for lobster traps and floats. When the morning sun came out through the fog, an island appeared on our starboard. Up to then we had been aware of an occasional bit of something floating in the grayish water, but with the clearing fog, we could make out literally hundreds of multi-colored lobster floats bobbing in the cold blue water of the Atlantic.

What before we had only heard as a chug, chug, chug now turned out to be the lobstermen's boats as they visited their traps. We were to learn more of these men and their adventures later in our stay on the island. I was told that each lobsterman makes and paints his own floats and unerringly travels to each one marking a lobster trap baited and lying on the sea bottom. For the life of me, I could never tell how he knew where each was placed as he looked for the trap in the fog. I was told they never lose one except to a storm.

By this time we had become accustomed to the fascinating accent of the other passengers. They were mostly natives of Maine who lived on Matinicus or who were visiting their families and friends on the island. Our skipper was apparently too busy avoiding the rocks which began to appear more numerous as we neared our destination. The island is approximately three miles long and about a mile across. The skipper brought us deftly through the maze of other boats in the harbor, and at last – three hours from the time of our departure – we arrived at the dock. I immediately learned that if I was to have assistance in getting my freight off the ferry, I would have to pitch in and help unload the boat. After the restful trip and the invigorating air clear of all man-made impurities, I was ready to work and joined in the line relaying the cargo from hand to hand until all was now dockside.

Our letter affirming our desire to rent a small cottage, the only one then being offered to let, had brought an accommodating fellow, Mr. Bunker, down to the dock with a pickup truck. He helped me load our gear, and with the family riding in front with him, I hopped into the back and bumped along over the dirt roads taking in the view of land and sea.

One of the things we learned about vacationing on a small island in New England is the importance of buying all necessary provisions for the larder at the local store. We had heard of those who came up from New Jersey and Long Island in the summer time bringing cases and boxes of canned goods with them. This not only alienated the local people whose economy depends on the local store, but was also costly as by the time the food was carried on the ferry the price of it was higher than at the local store. Also, the local people were unhappy to the point of refusing transportation to the outlying camp. All our goods were hauled free by our landlord, Mr. Bunker, and he took us back to town so that we could do our grocery shopping, and later delivered it for us.

We were now safely established in our vacation cottage on the shore of a small cove with a northeast exposure allowing us to see nearby Birdrock better known as Gull Rock, Cannonball Island, and Ragged Island. We had a late lunch, had the freezer section of the refrigerator (which ran on bottled gas) well stocked, the ham gear set up in one corner of the front room near the fireplace, when Mr. Bunker drove up with a five-gallon can of gasoline and two quarts of motor oil for the alternator. We were all set to begin our DXpedition except for installing the antennas.

News travels fast in New England, and it travels even faster on Matinicus. I was wondering how one man, one woman, and a lad of fourteen would get the 40 ft telescoping mast erected, guyed, and sporting two beams without accident. Ed, the junior op, mentioned that there was a man coming along the shore and into our cove. In that delightfully informal way that the people of Maine have, he introduced himself and then said, "I hear you have some radio equipment with you."

Not being short of words myself, I quickly introduced him to the family and then the ham gear. He was Charlie Pratt, the local telephone man on Matinicus. He

had singlehandedly installed telephone wires throughout the island to all the residents who for a small sum per month could keep in touch. In the meantime, the telephone company on the mainland had installed a microwave telephone station on the island and employed Charlie to take care of the power generators and make periodic checks by radio with the home office. He also was the designated Civil Defense contact for the island and the CD net on the mainland. His interest in ham radio had led him to visit us and glad I was to see him. He said he would help me get the antenna up; and with Bette, Ed, and me on the three guy wires, Charlie did what I have never since seen done. He stood on the next to the top rung of a small ladder which in turn was leaning untied against the mast. We had guessed the approximate lengths of the remaining guy wires which were fastened at the top of each 10 ft section except the last one. The 2 meter beam was at the top and spaced below was the 6 meter "hilltopper."

Charlie, although short of stature, is sturdy and his years of pulling up his lobster lines have developed muscles I don't even have. He would give a tug on a 10 ft section of mast, hauling along the antenna; guy wire, and coax. And up it went!

It still is hard to believe as I think back on it, but there it stood, and well guyed too, as it turned out. We had one whale of a summer thunderstorm with wind and lightning during our stay one memorable afternoon.

Our first contacts were strictly local Maine coastal stations, and evoked some comment since Matinicus had neither electric power nor licensed amateurs. Every expedition is subject to minor irritations and difficulties, and ours was no exception. About the second day on the air the Clegg Zeus went dead without a sputter. Charlie again proved himself a ham's best friend. When he came over after his day out in the lobster dory, he learned of my problem and asked if I could use a VOM. I traced my difficulty to one of two ballast tubes in the modulator power supply. Since the ferry makes its trip to the island on Tuesday, Thursday, and Saturday, sending and receiving an order by mail would mean at least a week off the air.

The island's 6 meter rig was connected to our antenna, the beam pointed southeast, and attempts were made to make a contact with one of my buddies, K1WPS, Murray of Marblehead, Massachusetts, who knew I was on the island and would be looking for my signals. As it turned out, I heard two of my friends in New Hampshire. It was difficult to break them as they lived on opposite hills from one another and I was not giving them more than a few watts of antenna power. Before they did sign off, I managed to get through with my order for replacement tubes and asked them to pass the traffic on to Murray.

The very next ferry had a package addressed to me with the necessary ballast tubes. Needless to say, we had no more technical difficulties for the rest of our stay. I was able to get into Massachusetts regularly several times a day and with no trouble each evening except one. I learned that every ham with any kind of gear on 6 meters was trying to raise K1OXK/1 on Matinicus Island. The QSLs began to come in from Long Island, New York, Connecticut, Rhode Island, Maine, New Hampshire, Vermont, and with some partial openings customary in August I worked North and South Carolina and several other southern states.

The real thrill of the DXpedition came one night as I was in QSO with a fine YL camping with her father in southern Maine when I heard a breaker calling me from W2-land. I had several contacts with other 2s and 3s on what appeared to be a very effective aurora. Suddenly, they were gone and I was in contact with the midwest. In short order I was working stations at the rate of four or five every two or three minutes. Each time that I signed over it was like turning on the switches on ham rigs all over the country. In a matter of moments every ham who could copy my signals was calling: "Hi Bob, do you copy WAØXXX?"

I had to do what you have heard Wayne

Green and all those other fellows do who go on rare DXpeditions. I began looking up and down the band 20–30 kHz to find one voice among the many that could be copied. You will readily imagine my surprise the following morning when I learned that Massachusetts had had no opening on six meters that eventful night. It was the only night I didn't keep schedules with my friends in Massachusetts.

I hesitate to close this account without telling you that we witnessed the fiery results of what appeared to be a feud on the neighboring Ragged Island. It seems that whenever there are *claim jumpers* or perhaps more appropriately trap robbers, all *hades* breaks loose on their Maine Islands. Whole families have been known to disappear and never be heard of again on their home island. It was one of those beautiful clear days with a soft breeze blowing across our cove. I could hear the ignitions of the engines on the lobster boats buzzing in my speaker sometime before they crossed into sight of the cottage. I looked out the window to see if the lobsterman was going to enter our cove and spotted instead a wisp of smoke where I thought there shouldn't be any. I rushed out to the bank which protected us from the storm's high waves during inclement weather, and caught a good view of what by now was obviously a great fire burning on Ragged Island. What I had thought was a boat's ignition proved to be the Coast Guard plane flying back and forth observing the blaze at Creehaven.

Later that day we learned at the general store that one of the residents of the neighboring island had somehow made enemies who took advantage of his absence from the island to burn his house down. So you see fellows, and gentle readers, all is not always sweetness and light, calm and peace, even twenty-five miles out in the Atlantic. Should you care to walk the trails among the blue spruce, pick wild blueberries, and strawberries, and apples, and feast on Aunt Lizzy's homegrown vegetables, I think that I should warn you. Today you don't need to take your own generator for there's power on the island now. Right, you guessed it; Charlie Pratt, the telephone magnate and lobsterman supreme, the CD chief, and antenna installer, is the new utility expert. He has installed power lines to each home and no longer do the residents have to run gasoline powered washing machines nor generate power for their color TV. I had the honor of being the first ham ever to have his signals read on a color TV on Matinicus Island. Fortunately, the owner of the TV was more intrigued by the situation than the ones I have met with at home. (Besides, if I remember correctly, he was Charlie's uncle – and Charlie could square anything.)

We had planned to return to our cove the next year, but our inquiries about the cost of such a cottage led to an unanticipated early purchase by the judge who had been renting it in all the previous years. We can't go back to that cottage, but I know we shall never forget how we spent an August "down Maine" and met one wonderful lobsterman trying out our own version of *DX America first*.

. . . W6LZJ■

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PHONE PATCH NO COST NO WIRES

In the past I have read many articles about phone patching. All of these had some form of actual wire attached to the telephone company lines. Similar attachments are needed for the commercial patch, either in kit form[1] or purchased as a complete and finished piece of gear[2]. Another point which was hammered at, was the impedance matching to the telephone lines, which seemed to scare me away more than anything else. Then there was the fact of a $20 to $30 outlay for the patch (I always found something better to do with the $20 or $30).

In my travels along the shelves of used-book stores, I came across an article[3] which seemed, with a little revision, to be just what I wanted in the way of a patch without any of the bugaboos I had read about in the past. The cost turned out to be not a single red cent and nothing was wired into the precious lines of the telephone company. I will attempt to go through my construction of the patch as I revised it and present the problems that showed up and what I did to clear them up.

The construction is simple, straightforward and noncritical. The heart of the patch as I constructed it was a used automobile ignition coil. New, an ignition coil can cost about $9 or more. This cost can be avoided by asking a local service station operator for a used, discarded ignition coil. Maybe I was fortunate in the first coil I tried. A few may have to be checked out. The coil that was given to me was grease covered. I wiped it clean and used steel wool to clean the 3 terminals. One binding post terminal is primary positive, one is common negative, and the third is the "tower" secondary positive. The continuity of the primary and secondary coils are tested with an ohmmeter to see if it is shorted beyond use. The primary

positive to common negative was about 1.5Ω. The tower secondary to common negative was about 10 kΩ. The remaining needed parts for the patch came from the overflowing junkbox. These were:

1. About 40–50 ft of thin enameled wire. I used 24-gage because I had a spool of it, but any small-size wire can be used if it is insulated and not so fragile that it breaks with a small amount of abuse.
2. Two-conductor shielded wire about 18 in. long.
3. Two alligator clips.
4. A two-conductor coiled cable, the kind that contracts when not in use and can be pulled out to a length of 3–4 ft on extension. I took this from an old telephone. This was used only as a matter of neatness. The patch will work just the same without it.
5. Assorted nuts, bolts, washers, tape, etc.

Construction

Clean up the ignition coil, check it out, and set it aside. Using the 40–50 ft of enameled wire, I left a lead of about 2 ft and started to wind the remainder of the wire around the earpiece of the telephone. I found that if I confined my turns to the screw-on cover of the earpiece and not let my turns work their way on to the handpiece, it was much easier to remove and tape the turns together. I made about 60 turns of wire around the earpiece rim and left about a 2 ft lead when I finished.

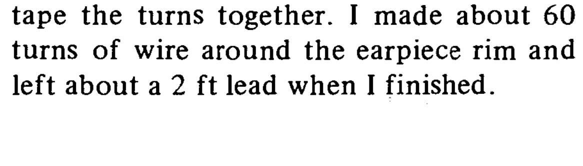


Fig. 1. Schematic representation of induction patch.

I had precut four pieces of tape about 1 in. long and as I lifted part of the formed loop from the earpiece I bound that portion of turns together with the tape. This was repeated at four spaced intervals; as the wire loop was completely removed from the telephone it retained its shape. I was now able to replace this loop back on the earpiece with slight pressure.

The phone patch works even with this induction loop held about ½ in. away from the earpiece. So do not worry if the loop will not go back onto the earpiece and fit as it did before removing it.

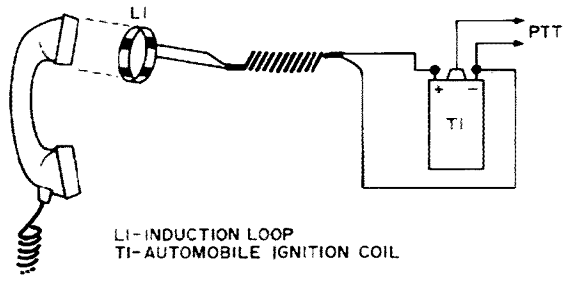


Fig. 2. Pictorial schematic shows patch connections.

If the coiled cable is used, the following steps should be taken. The coiled cable I used had four conductors: two white, one pink, and one black. This was great because I only needed two of these and this meant I had a built-in color code. I removed the insulation from both ends of the pink and black wires. The ends of both white wires were cut short to be out of the way. After removing the insulation from the wires I discovered that these wires are special in that they are multistranded and that every two strands were braided with a thread. This thread was unraveled by rolling the two wires between the fingers. The freed thread is cut away.

After all the ends were ready for soldering I found out I could not solder these wires. In order to secure the induction loop to the coiled cable I first cut the lead lengths on the induction loop down to about 4 in. and steel-wooled the enamel of the last 2 in. A homebrew binding post was made to secure the induction loop leads to the coiled cable leads. Two such binders were needed. These consisted of a small bolt, long enough to accommodate two washers, the two leads to be united, and a nut.

One washer was slipped on the bolt up to the head of the bolt, the two wires were wound on the shaft of the bolt up close to the washer, one lead from the induction loop and one lead from the coiled cable. (It

does not matter which lead goes to which wire of the loop.) The second washer is slipped on and the nut follows this and is tightened to clamp the two wires between the washers. The remaining lead from the induction loop and the remaining wire from the coiled cable were united in the same way.

We now have, if you used the coiled cable, one induction loop attached to the end of a coiled cable. If the coiled cabled was not used, you have an induction loop with 2 ft leads, cleaned of insulation for about 2 in. at the ends.

The free ends of the coiled cable or the ends of the induction loop leads are now attached to the ignition coil binding posts. It does not matter which lead goes to which of the following binding posts. One lead to the primary positive and one lead to the common negative. The primary positive post can have its nut tightened at this time, but leave the nut on the common negative loose. Prepare a 2 in. length of insulated wire with an alligator clip on one end and no insulation on the other for about ½ in. This bare end is placed around the binding post of the common negative and the nut is tightened.

Remove the tower terminal and clean it with the steel wool. Prepare another insulated wire as just done. I soldered this wire to the inner portion of the tower conductor and I replaced the conductor inside the tower. These last two leads that are from the tower terminal and the common negative I elected to connect to my mike PTT switch because this saved me the trouble of going into the rig and it also provided me with an extra control switch in addition to the PTT switch on the rig.

The preparation of the mike to the ignition coil is the final step in completing the patch. On the breadboard circuit I used two separate wires for this step without any problem.

The PTT switch on my mike is on the upright hand grip. The hand grip is hollow, so this is ideal. I unscrewed the PTT switch and pulled it away from the hand grip to expose the switch tie points. At this time both ends of the shielded cable were prepared. One end of the shielded cable was slipped up the hollow center of the hand grip from the bottom of the open base and fished out the hole of the PTT switch. My PTT switch has two tie points, and one of the leads was soldered to each tie point. It makes no difference which wire goes to which tie point. I did not solder the braid of the shielded cable to anything. It was cut back close to the insulation to get it out of the way, because I found that if I touched it when the rig was on VOX my rig went into the transmit mode. The PTT was replaced after making sure that there were no shorts and solder bridges.

The remaining end of the shielded cable coming out of the bottom of the mike has the end prepared as follows; about 3 in. of outer insulation and the shielding braid were removed. The remaining insulated wires were cleared of insulation for about ½ in. These ends were each given a coating of solder to keep the strands from wandering and to give it some strength. Some 1/8 in. spaghetti from the junkbox was cut to give me two pieces each about 2½ in. long. These were slipped over the soldered tips of the shielded cable conductors and pushed back far enough so that the bare wire was exposed. Do not connect the leads from the shielded cable to the ignition coil at this time.

I turned on the rig and while it was warming up I placed the induction loop over the earpiece of my telephone. This was a real live telephone. I replaced the telephone handpiece to its cradle to kill the dial tone. I tuned to an unoccupied frequency and tuned up the rig. I placed the PTT switch on the rig in the OFF position and the PTT switch on the mike in the ON position. I then attached the two alligator clips from the ignition coil to the leads from the shielded cable just installed in the mike.

I advanced my mike/CW level just a bit more than I usually have it during normal voice operation. I now placed the rig PTT switch in the active position which is VOX on my HW-100, and I heard a hum in the speaker which was never there before. I will get back to the hum later. I lifted the

handpiece of the telephone from the cradle and the dial tone activated the rig into the transmit mode. I replaced the telephone handpiece and the rig went into the receive mode.

If the dial tone does not activate the rig to transmit, raise the mike/CW level. If this does not make the dial tone activate the rig then replace the handpiece and reverse the alligator clips to the shielded cable. Lift the handpiece again and the rig should go into transmit when the dial tone starts. Make a note of which lead goes to which clip.

The patch is now ready to transmit through your rig from the telephone. In fact, that is all this patch does: It lets the telephone earpiece activate the rig and whatever is coming into the earpiece is transmitted. So how is the signal received by the rig sent over the telephone? This I have done by the very simple method of plugging in my earphones and placing the earphone over the mouthpiece of the telephone. It may not be the latest in circuitry but it works.

You can also place the mouthpiece of the telephone near the speaker, but since all transmissions from my station are my responsibility I monitor all patches. This was simplified by fashioning a retaining ring that slips over the mouthpiece of the telephone and holds the earphone in place. In this way, I can hold the telephone as in normal use or I can rest it on my shoulder, leaving both hands free. If your hearing is better than mine, you can leave the whole thing on the operating table in front of you.

As this phone patch now stands it must be worked on a PTT basis. The mike is active on my circuit and I can break in by use of the mike or the telephone mouthpiece.

Now about that hum I heard: I found that it was dependent on where the ignition coil was placed on the operating table, so I kept moving the coil around until I found a spot where the hum went away and this is where I place the ignition coil whenever a patch is to be made. When not in use, the induction loop is removed from the telephone and hung over the tower terminal. That takes care of all the attachments to the telephone. The alligator clips are removed and clipped together and the patch is put away.

Now for the two leads coming from the bottom of my mike stand: The spaghetti pulled over the exposed ends of the two wires and the wires are bent back on themselves and tucked up the hollow mike stand.

Summary

My ignition-coil phone patch is shown in Fig. 1, and the deployment is pictured in Fig. 2. There are no interconnecting wires to the telephone lines. Since the audio introduced into the telephone lines is nothing more than audio there is no worry about adding any voltages to the telephone lines. I wonder what would happen if I cascaded a few ignition coils?

. . . WA2EAW■

1. Heath kit.
2. Johnson phone patch.
3. QST, July 1969 "Ductopatch."

With 81 miles of ski trails, serviced by 16 aerial lifts, Mt. Snow is now ranked as the world's busiest ski resort. Where the trails come together at the summit, the WA1KFX machine reliably repeats FM signals from 146.31 to 146.88 MHz, month in and month out, in weather where zero is considered warm.

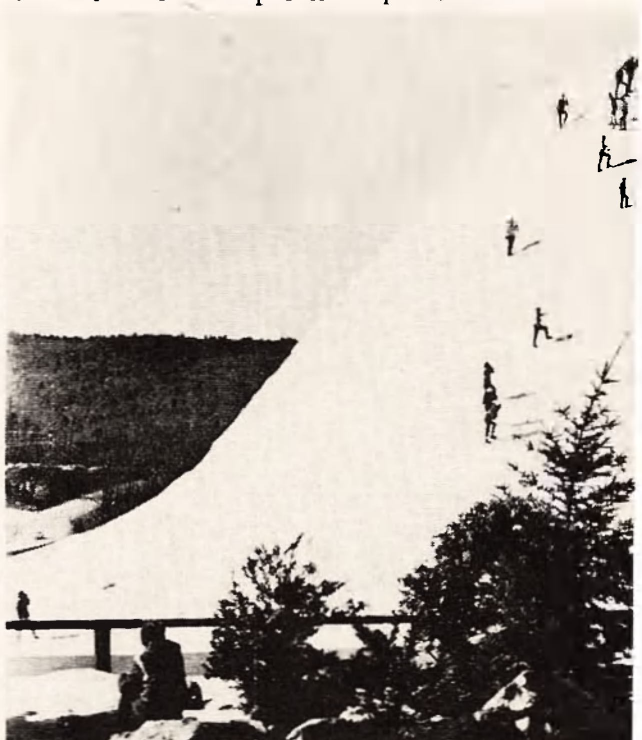
To The Repeater – ON SKIS!

Installing and maintaining a repeater on an isolated mountaintop usually means a lot of lonely hours for the fellow who does the work. But at least one repeater man feels it doesn't have to be that way. Gordon Pugh, W1JTB, who has probably set up more repeaters along the eastern seaboard than any other amateur in the country, makes it a point to select his sites so that he can combine his "business" with his pleasure.

Gordon's "business," in this case at least, is setting up repeaters that have greater coverage than other systems in his area of the country. The "pleasure" is skiing. And Gordon's most laudable effort recently has been the deployment of his 146.31/146.88 MHz FM repeater at Mt. Snow, Vermont.

Mt. Snow is an extraordinary place. Europeans and Americans alike might find it difficult to believe that Mt. Snow is actually the largest ski area in the world – but it really is! With as many as 10,000 visitors on a good skiing day, Mt. Snow goes unchallenged as "biggest." Not even those renowned resorts in Switzerland can compete with Snow in terms of human traffic.

The mountain is not particularly high – at least not by worldwide standards. But at its 3600 ft perch atop Mt. Snow's

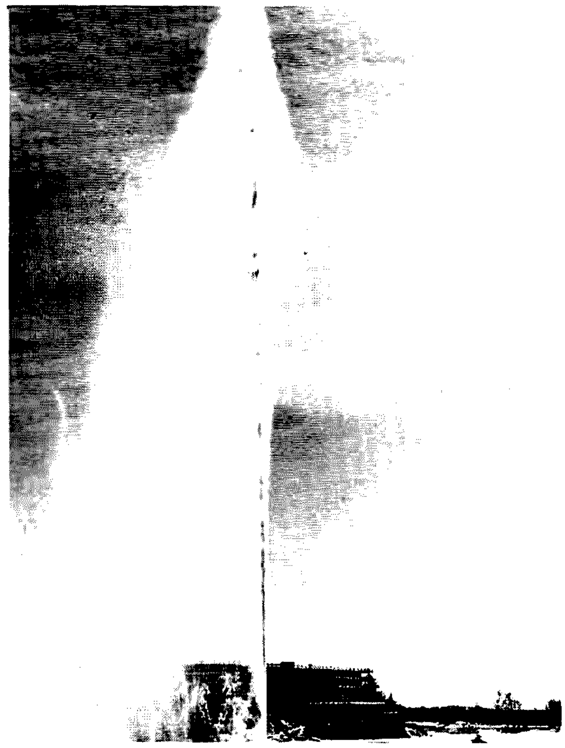


The glacier towering above the pool is called Fountain Mountain, and it was created by the snowy fallout from a geyser jet of water shot at tremendous pressure from underground. Fountain Mountain takes nearly two months to build; but it "happens" every year.

famous *North Face*, the .31/.88 machine, licensed under the call of WA1KFX, provides effective automatic relay coverage in five states – New York, New Hampshire, Massachusetts, Connecticut, and, of course, Vermont.

When Gordon Pugh services his Mt. Snow repeater – which is curiously nearly every weekend in winter and virtually never during summer months – he arms himself with all the tools he's likely to use and myriads of items he's not; then he packs up his skis and vacation gear, and off he goes – sometimes for days at a time.

If things really need fixing at the repeater site, Gordon's first day is usually spent in earnest. He's been known to spend as much as seven hours on the top of a tower at one sitting. He makes a marathon of the repeater repair job, staying with it until the task is done. In the unheated, open area where the WA1KFX repeater is installed on Mt. Snow, the temperatures frequently drop to the uncomfortable side of zero and remain there for long periods. But Gordon simply plugs in a 1 kW bulb



(for heat more than light) and hacks away at the problem. When it's licked, the funtime starts.

From the top of North Face, Gordon has a wide choice of trails on which to descend. An expert skier himself – and a part-time ski instructor, Gordon usually chooses one of the brisker slopes – like Snow's *Jaws of Death* or the *Challenger* both carefully marked, "For experts only."

If there's still daylight left when the repeater is once again operational and he's descended to the Snow Lake lodge area, Gordon will take maximum advantage of the remaining hours. With no less than 16 lifts to choose from, and 42 descent trails, he'll spend the day tackling the Main Mountain, with its thousand acres of ski facilities.

"The trip to the top is almost as much fun as the race down the mountain," Gordon says. And he's not kidding. There aren't many thrills equaling that of scaling the mountain in one of Mt. Snow's "skis-on," enclosed gondolas. The gondola lifts you high above the tree-studded mountain side and offers a breathtaking panorama of scenery.

"What I like about Snow," says Gordon, "is the solitude. The 80-odd miles of ski trails are sufficient to accommodate the hordes of visitors without crowding.

There's something about a solitary trip down the mountain that puts you in pretty close contact with Nature." With an almost reverent, poetic tone, Gordon added, "When the wind isn't blowing too hard, the only sounds you hear are the swishing of your skis and the rustle of the trees."

At the lodge, Gordon always winds up his day with a swim in the heated outdoor pool. It doesn't look comfortable when the air temperature is in the low teens, but Gordon insists that it is. The water temperature in the winter is rarely below 100° F, he says, and a swim is more refreshing than a hot shower.

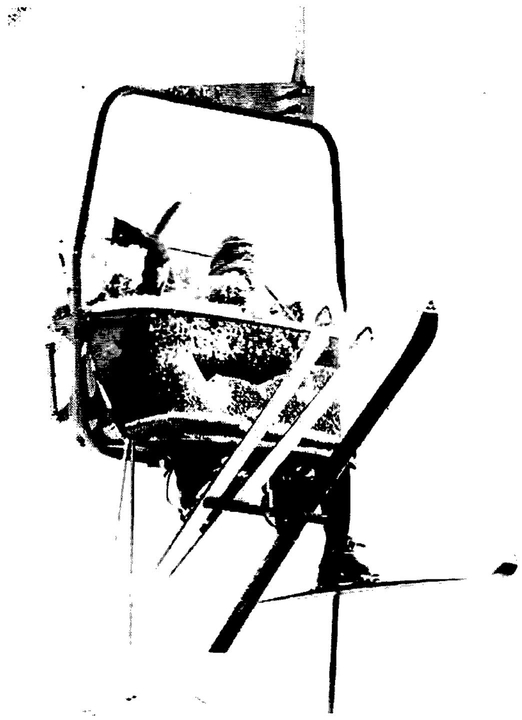
Some of us conservatives remained skeptical about the comforts of swimming outdoors in below-freezing weather, though. And it didn't help a bit to see Gordon's hair freeze into brittle spikes when his head came out of the water.

It certainly made an interesting picture, if nothing else. What is more incongruous than a photo of swimsuit-clad bathers with bundled-up skiers gliding over a snowy slope in the background?

That "slope in the background" is one of Mt. Snow's more interesting attractions. The hill, called *Fountain Mountain,* is a glacier made as a cooperative enterprise by man and nature. The management at Mt. Snow provide the geyser-fountain – tons of water jetting nearly 400 ft into the sky. Nature provides the water-to-snow conversion. The result is a glacier that takes several months to build.

The water geyser gets turned on when low-temperature season comes around – usually late in November. For a month or two, the geyser continues, day and night, while the glacier grows and grows. When the water is finally shut off, the glacier, with its ski-able snowlike surface, stands a full 200 ft. Skiers can then negotiate the miniature mountain until well into April.

Mt. Snow is an ideal repeater site, as the coverage performance of the WA1KFX machine will attest. It towers high enough above the surrounding countryside to make the .31/.88 machine accessible from even flea-power units like hand-held transceivers and battery-operated portables. But there are FM'ers who use Mt. Snow for communicating on frequencies other than those of the Snow system. Wayne Green, for example, likes to take his Motorola Handie-Talkie down the slopes of Snow, talking to distant amateur stations on a "direct" basis.

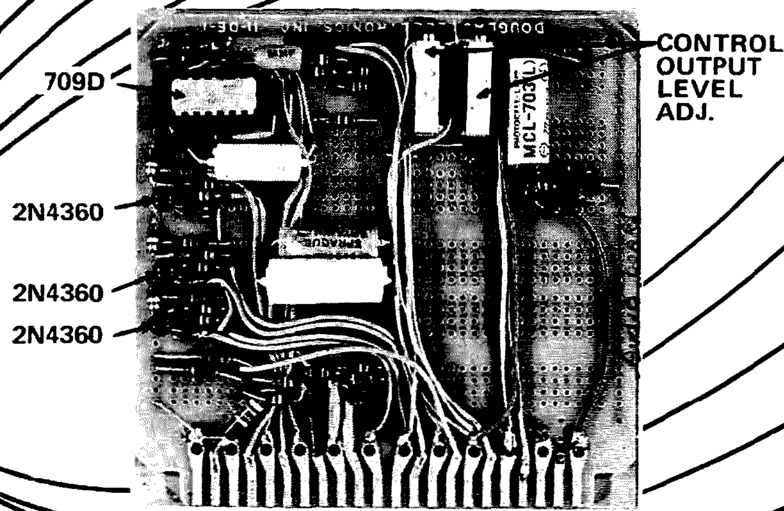


When Gordon makes a repair trip to the repeater site, he does it in style. During summer, he'd have to walk up; but in winter, it's easy going all the way – in an enclosed skis-on gondola that offers warmth as well as a panoramic view of the mountain.

Wayne also noted that other New England repeaters are accessible from Mt. Snow's *Main Mountain*. Heading down on skis at a neckbreaking clip, Wayne managed to combine two hobbies in one, and was able to talk through a number of New England repeaters during the course of one trip. Transmitting on 146.34 MHz, Wayne communicated through W1ABI, W1KOO, W1ALE, K1ZJH, W2NSD/1, and probably other repeaters that weren't active during the minutes of his descent.

For people who question Gordon Pugh's frequent trips to Mt. Snow, he offers a two-edged answer. If the query comes from a skier, he'll say, "There's more to snow resorts than skiing." And to curious amateurs, he says, "There's more on Mt. Snow than a repeater."

REPEATER AUDIO MIXER



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The audio mixer described in this article, although designed primarily for repeater use, can be used anywhere it is desired to mix a number of audio inputs with a high degree of isolation between inputs. The mixer is adaptable to almost any configuration which may be required to suit the individual's requirements. The number of inputs can be increased by a factor of two or three to suit the user's needs. The isolation between individual inputs of over 40 dB makes it possible in repeater operation to have tone command information on one channel not be affected by another input. The mixer shown in this article is the one designed for use in the WA1KFY repeater. It has eight inputs – three of them squelched, the other five continuously on.

Operation

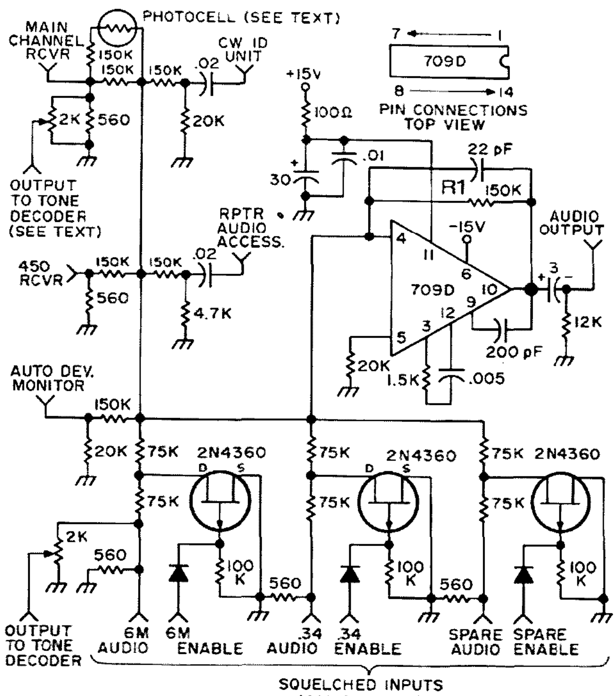
The amplifier uses a single 709D opamp plus one FET for each squelched input. The audio inputs as shown in Fig. 1 are applied to the opamp's inverting input. The output is fed back through 150 kΩ resistor R1. Notice that the signal from each input is applied through 150 kΩ also. The resultant voltage at the input terminal of the opamp is the combination of the input signal plus the out-of-phase feedback voltage. Since both are applied through equal series resistances, the resultant voltage is zero. This condition results in the opamp's having an extremely low (almost zero) input impedance. This resultant low impedance, together with the high series resistance on each input, accounts for the high degree of isolation between inputs. The squelched inputs use a FET across each input as a switch. With zero volts on the gate, the FET exhibits a drain-to-source resistance of about 350Ω, effectively shorting its associated input to ground. When +15V is applied to the gate, the FET switches off, enabling the input channel. The 75 kΩ resistors between each FET and the input bus prevent the input bus from being shorted by the FETs.

The gain of the opamp is determined by the ratio of the feedback resistance to the input series resistance. In this case, the gain on all the inputs is unity. If more gain is desired on a particular channel, the input resistance can be lowered to change the ratio (and therefore the gain). For example, it was found necessary to increase the gain from the main channel receiver when the phone patch was connected in order to increase the level into the phone line. (The phone patch does not load down the output; rather, the gain had to be raised in order to properly drive the line.) The gain change is accomplished by a photocell–lamp assembly, with the photocell in series with a second 150 kΩ.

The frequency response of the amplifier is essentially flat from dc up to about 8 kHz. Beyond that point, it rolls off. The 22 pF capacitor across the feedback resistor determines the rolloff frequency characteristc. The audio output voltage swing can go as much as ± 10V. This is more than ample to drive 10 or more high-impedance inputs. The audio amplifier in WA1KFY is presently used to drive three transmitters, a phone patch, and a monitor earpiece. The number of inputs can be expanded to suit individual requirements. The unsquelched inputs require only an additional 150 kΩ series resistor and load resistor for each leg. The squelched inputs each require an additional FET switch in addition to the load resistor and series resistors.

The opamp requires 15V (positive as well as negative) to operate it. The current requirements are approximately 30mA. The components shown in the detail schematic (1.5 kΩ 0.005 mF, and 200 pF) are used to compensate the amplifier against instability. The 100Ω resistor, 30 μF capacitor and 0.1 μF capacitor on the +15V line form a decoupling network.

Two trimpots at the top edge of the board (see photo) are used to provide audio outputs for tone-operated command functions. They are connected across the load resistors of the six meter receiver and the main-channel two-meter receiver as shown in Fig. 1. The arms of both pots connect to pins on the edge connector and



Notes:

1. Resistance values in ohms, capacitance values in microfarads unless otherwise noted.
2. Diodes are IN457'S.

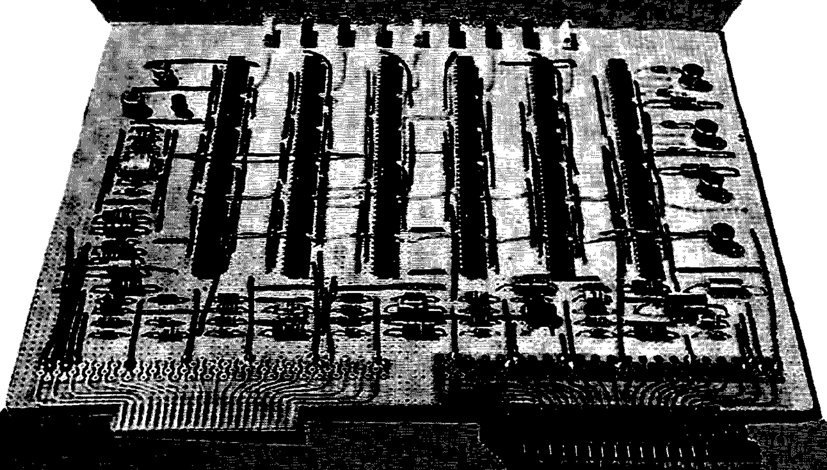
Fig. 1. Audio summing amplifier.

go off the board to their associated tone decoders on another board. These pots are mounted on the audio mixer board as a matter of convenience and would not be used if it is not required to bring audio to another point in the system for tone command or other functions. The photocell–lamp assembly for gain changing on the main channel input is on the right side of the board. Similarly, it could be deleted if this feature is not required.

Summary

This audio mixer provides the repeater owner a high-quality audio mixer system which has minimal space and power requirements. It is especially attractive for use in more sophisticated repeater systems where several receiver/transmitter combinations are used. However, if the same construction techniques as those described in this article are used, it is just as good to use with a simpler repeater system because there is more than adequate room for expansion at a later time.

...W1ELU,W1IRH■



Ken Sessions, Jr. K6MVH

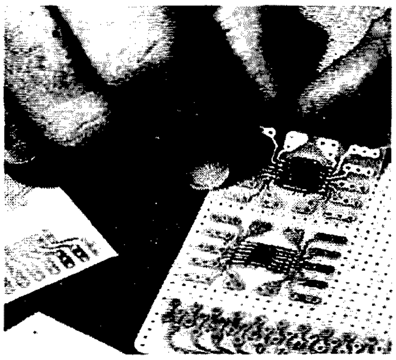
SOMETHING NEW IN PC CONSTRUCTION

One of the nice things about being associated with a major ham magazine is that I get a chance to preview a lot of interesting products. Some of the things I get to see are obviously gimmicks that will never take hold. Others are reasonably new good ideas, most of which are doomed to oblivion because the cost exceeds the ultimate value to the user. But once in a while – not often, mind you – but just on rare occasions, I get the chance to see something that smacks of real greatness.

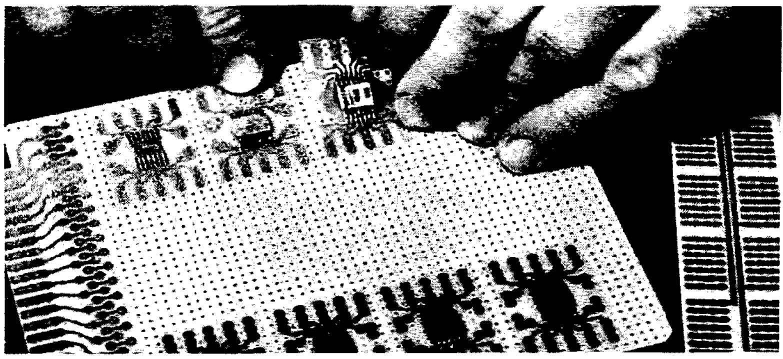
Such is Circuit-Stik, an item that I think is the most important development in the history of printed-circuit construction. I think this item is important because it will permit any amateur to make even the most complex circuit boards without any art, camera work, photoresist exposure, or etching. And that's really something!

You can get Circuit-Stik in a kit that includes everything you need to make professional circuit boards, but I haven't the faintest idea what the price is. A quick letter to the manufacturer will get you that information in no time, I would imagine. It's the *process* itself that I'm excited about. The trouble is, it's extremely difficult to describe it adequately, even with pictures.

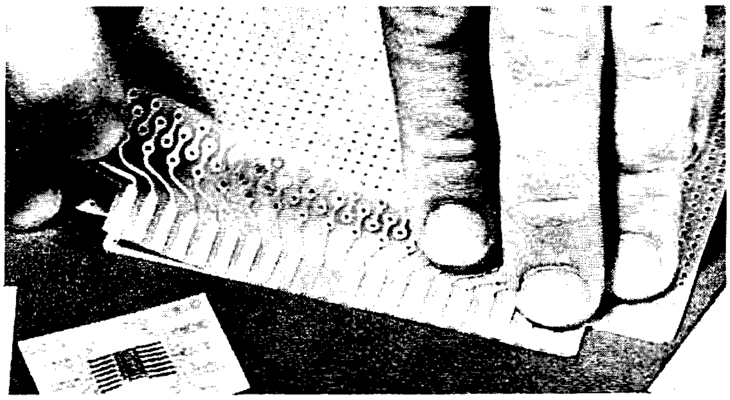
I'll try explaining it anyway: The kit includes a fairly large sheet of perforated board with very close-spaced holes (on 100-mil centers). From this sheet, you can cut your basic circuit board to whatever size your project might require. But rather than etching circuit paths onto a copper-clad layer, you can lay the circuit paths down onto the board with already-



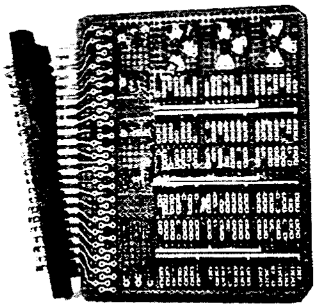
A wide variety of circuit-element patterns are available allowing the user maximum flexibility in his selection.



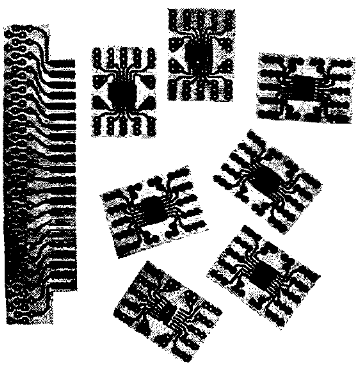
When MSI or LSI components are pre-lead bonded to Circuit-Stik subelements, (as the "flat-pack" units have been in the photos), they can be immediately tested in a circuit or become part of a permanent circuit board in minutes.



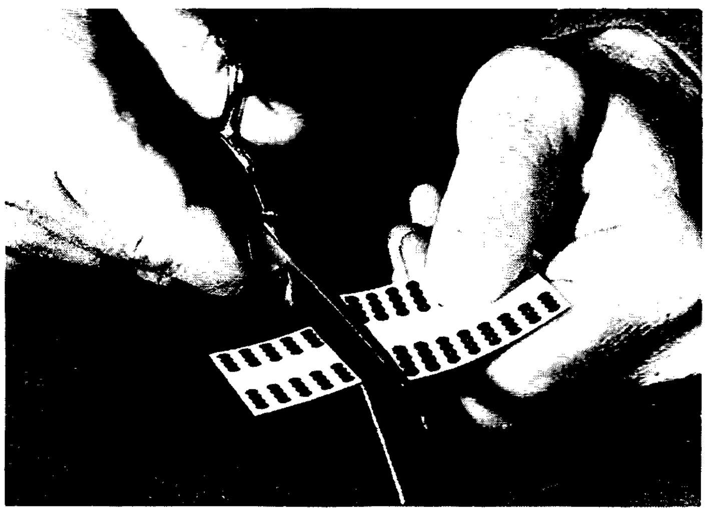
Circuit-Stik subelements are pressure sensitive and the adhesive formula offers exceptionally good adhesion strength, withstands soldering temperatures and yet may be removed for easy circuit design modifications.



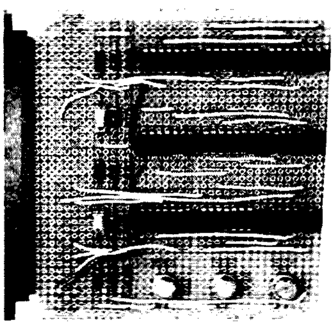
Circuit-Stik "1000-series" subelements are designed "on-grid," are pre-drilled, and when used in conjunction with .100 inch punched board, require no drilling



All subelement conductors are preplated and ready for soldering



CUT FOR NUMBER OF COMPONENTS REQUIRED



No terminals are needed as active circuit components are soldered directly to the subelements and resulting circuit boards made from Circuit-Stik materials are as durable and reliable as conventional printed circuit boards.

prepared patterns that are gold-plated or tinned copper on thin adhesive sheets ol epoxy-glass.

The adhesive-backed conductive patterns are called "subelements," and they are available for virtually any transistor or IC package you could dream up. There are even subelements for all conventional card-edge connectors. The beauty in the system is that the subelements are all predrilled, and the holes fall directly over the holes that already exist in the perfboard. So making a complete board for any project is nothing more complex than laying out the board with a pencil and paper, then dropping the subelements onto the board in their proper positions.

I don't know what kind of adhesive is used on these superthin patterns, but it certainly does hold. And no matter how much you solder to the patterns and paths, they stay down. If you place a sharp knife under a pattern or circuit path, you can lift it without sacrificing any of its holdability, then reposition it anywhere else on the board.

. . .K6MVH■

READING 5 CODE RTTY in BINARY

000 000 111 011 000 000

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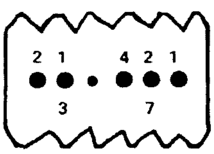
Ever try and read the tape that you just printed off your Model 19? Here is an interesting way of reading it, using the binary system. Look at the tape from the top with two holes to the left of the sprocket and three holes to the right of the sprocket. Group the two to the left, to read 2-1 and the three to the right to read 4-2-1. Now all you have to do is add up all the holes that are punched to the left as one digit and all the holes punched to the right as one digit. This will give you two digits which can be converted to a function on the machine.

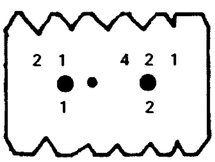
Example 1. If all holes are punched, add up the two weights on the left (2+1=3). Now add up all the weights on the right (4+2+1=7). You now have two digits which put together is 37. Look on the table and you find 37 would be the LTRS function.

Example 2. No. 1 hole on the left with a weight of 1, and the No. 2 hole on the right with a weight of 2. Put together, this is 12. Look on the table and you find 12 is the function R.

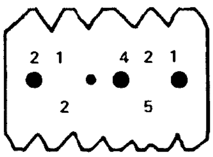
Example 3. No. 2 hole on the left weight of 2 and the number 4 and 1 hole on the right summed is a weight of 5. Putting the two digits together gives 25. Look on the table and find 25 is the Y function.



EXAMPLE 1



EXAMPLE 2



EXAMPLE 3

TABLE

01 =	T	20 =	E
02 =	CAR RET	21 =	Z
03 =	O	22 =	D
04 =	SPACE	23 =	B
05 =	H	24 =	S
06 =	N	25 =	Y
07 =	M	26 =	F
10 =	LINE FEED	27 =	X
11 =	L	30 =	A
12 =	R	31 =	W
13 =	G	32 =	J
14 =	I	33 =	FIGS
15 =	P	34 =	U
16 =	C	35 =	Q
17 =	V	36 =	K
00 =	BLANK	37 =	LTRS

If you study the table you can see that there is no wasted functions. There is a possible combination of 32 functions. If you add the 26 upper case operations we have 58 different possibilities. When reading the tape you should know if the tape is in upper or lower case. This should not create any problems. You could add one more function which is the blank.

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3 Unique Digital TTY Accessories

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Tulsa OK 74135

This article describes three accessories for the RTTY station. The first is a regenerative repeater; you put highly distorted, biased signals in one end and get nice, clean, properly timed signals out the other. The second forms the basis of an electronic stunt box; it performs the "cleaning up" function of the first, plus converting the serial TTY signal to a 5-line parallel signal which can be used to perform various functions on receipt of a specificd group of characters. The third performs all the functions of the first two plus speed conversions; with this little goodie you can put 100 wpm gears in your machine for copying the commercials and use the speed conversion function to operate at 60 wpm on the ham bands.

In order to understand the operation of these three devices, let's take a moment to review the manner in which a TTY printer decodes a signal. The start element of the code drops the selector magnet, initiating a mechanical timing cycle. Five times during this cycle the machine mechanically "samples" the condition of the selector magnet and positions the code bars accordingly. In a 60 wpm machine these samples are 22 ms apart and about 4.4 ms long. The length of time between the beginning of the start element and the first sample can be varied with the range adjustment. With the range control set at 60 the samples occur 33 ms, 55 ms, 77 ms, 99 ms, and 121 ms after the beginning of the start element. The Regenerative Repeater

The Regenerative Repeater

The repeater electronically samples the TTY signal in much the same manner as the printer. A start element initiates a series of seven sampling pulses. The input signal is sampled in the middle of the start element, in the middle of the five signal elements, and 11 ms into the stop element. The condition of the signal at the time of each sample is loaded into a flip-flop memory where it is stored until the next sample is taken. Thus, the output of the

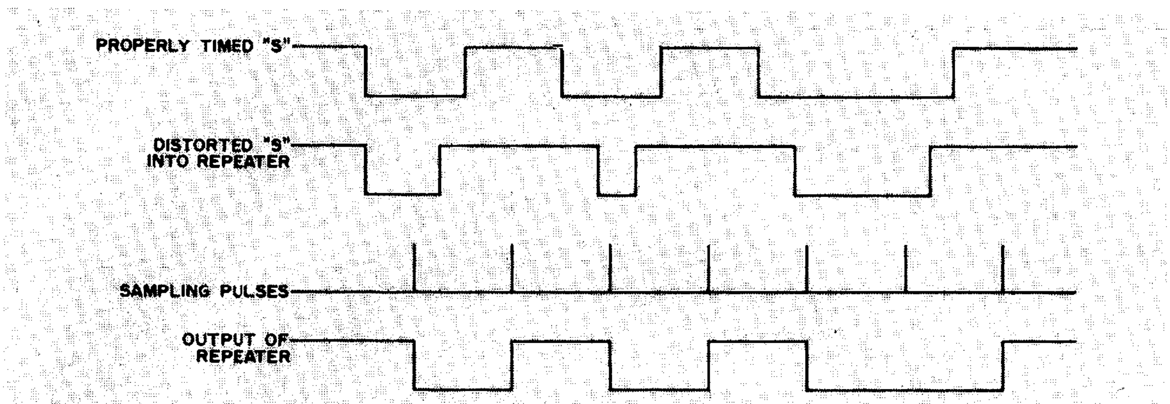


Fig. 1. Simplified timing diagram for regenerative repeater.

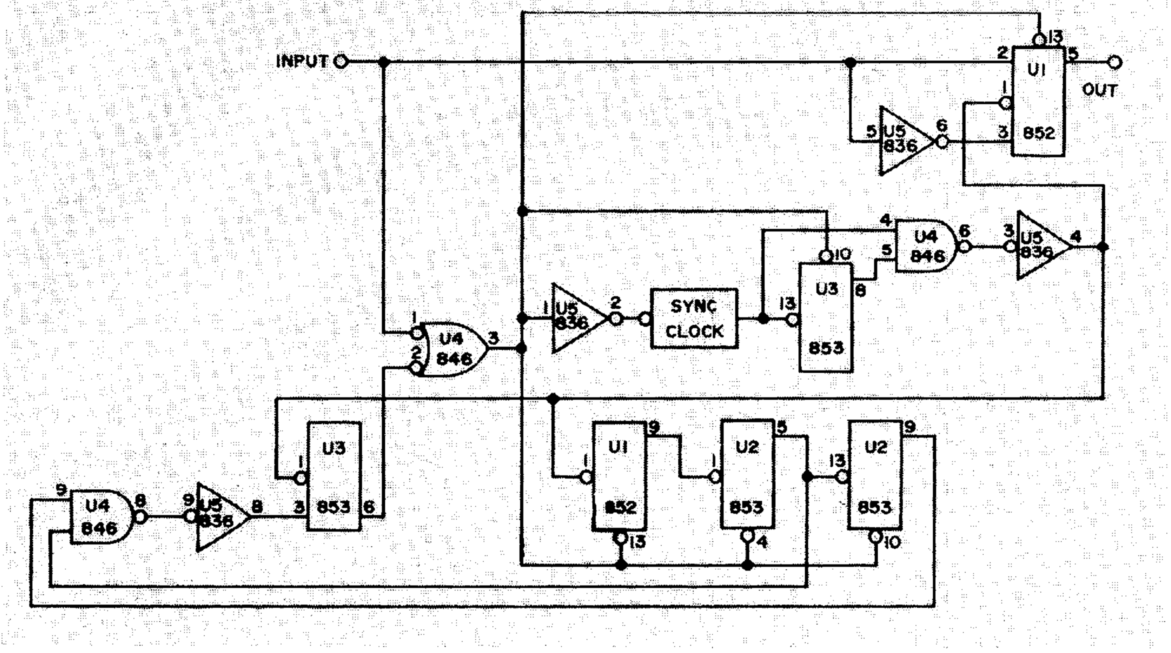


Fig. 2. Logic diagram for regenerative repeater.

flip-flop is a perfectly timed TTY signal, delayed 11 ms from the input signal, with signal elements corresponding to the condition of the input at the time of sampling (see Fig. 1). After the stop element is sampled, the circuit resets and waits for the next start element.

The logic required to perform these functions may be implemented in many different ways. The diagrams included here show 803 series DTL integrated circuits. It should be noted, however, that the same functions could just as well be accomplished with RTL, TTL, ECL, or HTL ICs, discrete transistors, or even tubes or relays, to name a few! with this series of DTL a high logic level is approximately +5V and a low logic level is approximately ground.

Referring to the logic diagram of Fig. 2 and the timing diagram Fig. 3, a start element (space) puts *nor* gate U4 input pin 1 at a low level, forcing output pin 3 and inverter U5 input pin 1 high. Output U5 pin 2 goes low, starting the 91 Hz synchronous clock.

"Synchronous clock" is simply a high-powered term for an oscillator that can be turned on in an orderly fashion; that is, the first cycle after the start command has the same period as all the following cycles. A simple oscillator of this type is shown in Fig. 4. It produces a series of narrow positive-going pulses at 11 ms intervals, the first occurring 11 ms after the input goes low.

The clock output drives divider flip-flop U3, the output of which is a square wave with a period of 22 ms. *Nand* gate U4 picks

out every other clock pulse and drives inverter U5 input pin 3. The signal at U4 pin 4 is the string of positive going sampling pulses. The first of these pulses causes JK flip-flop U3 output pin 6, which has been high until now, to go low. As long as the K input, pin 3, of this flip-flop remains low the following sample pulses will have no effect on its output. The low output at pin 6 goes to *nor* gate input U4 pin 2, causing the timing cycle to continue regardless of the signal at the input. Note, however, that this happens only after 11 ms of continuous spacing signal. This means that a spacing condition must exist at the input for at least 11 ms to initiate a timing cycle. This provides protection against noise on the signal line.

The first sample pulse also loads the start element into output flip-flop U1 pin 5 and causes the counter outputs, U1 pin 9, U2 pin 5, and U2 pin 9 to step from all (lll), the reset condition, to (Hll). The second sample pulse loads the first signal element into the output flip-flop and steps the counter to LHL. This process continues for pulses three through six. At this time the last signal element has been loaded into the output flip-flop and the counter outputs are LHH. This makes both U4 pin 9 and U4 pin 10 high, so U4 pin 8 and U5 pin 9 go low. Inverter output U5 pin 8 JK flip-flop U3's K input, pin 3, go high. The next sample pulse, which loads the stop element into the output flip-flop, also causes JK flip-flop output U3 pin 6 to go high. This, together with the condition on the signal line, causes *nor* output U4 pin 3 to go low, stopping the clock, resetting the counter to LLL, and forcing the output flip-flop to remain in the mark condition until the next start element initiates a new timing cycle. Just add some simple level converters to make your TU, printer, keyboard, and keyer DTL compatible and you're all set to clean up distorted received

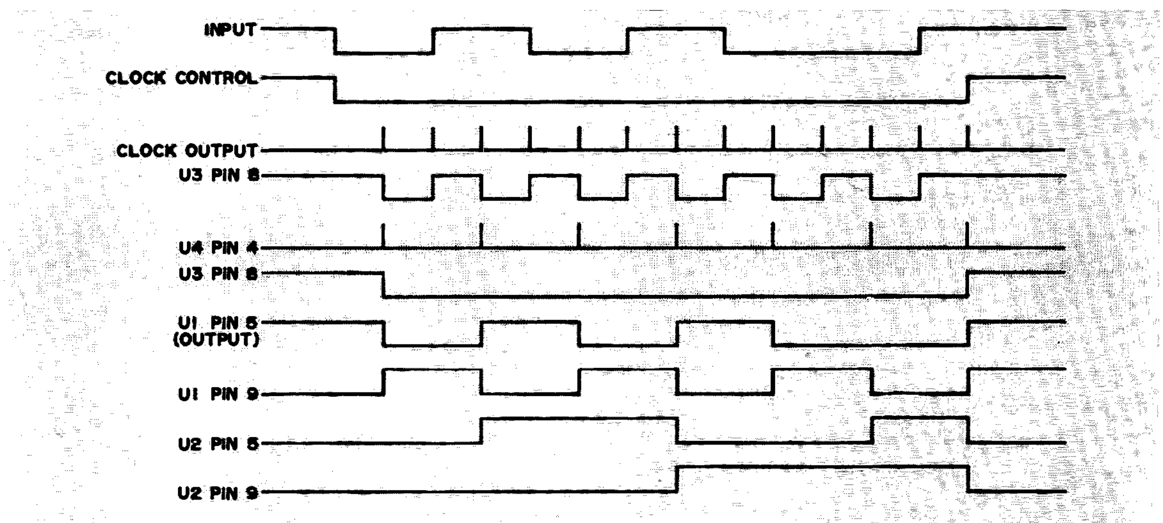


Fig. 3. Timing diagram for Fig. 2.

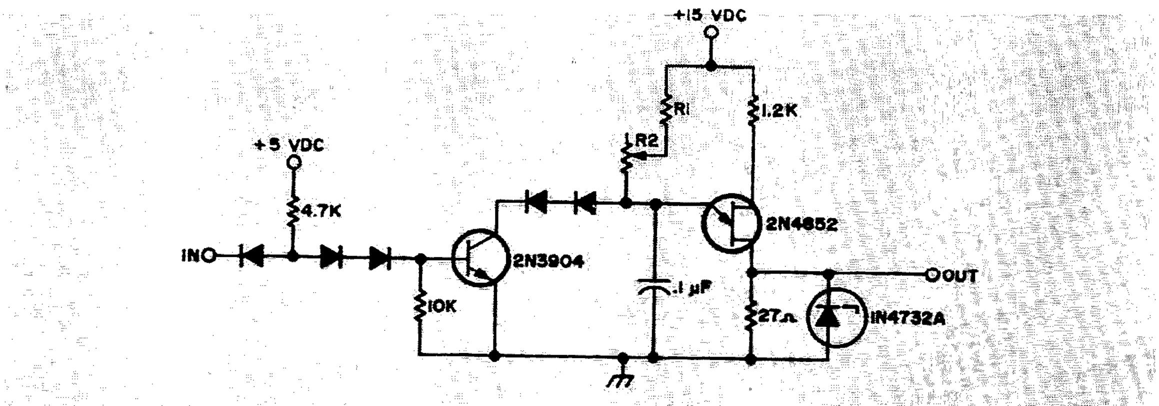


Fig. 4. Synchronous clock.

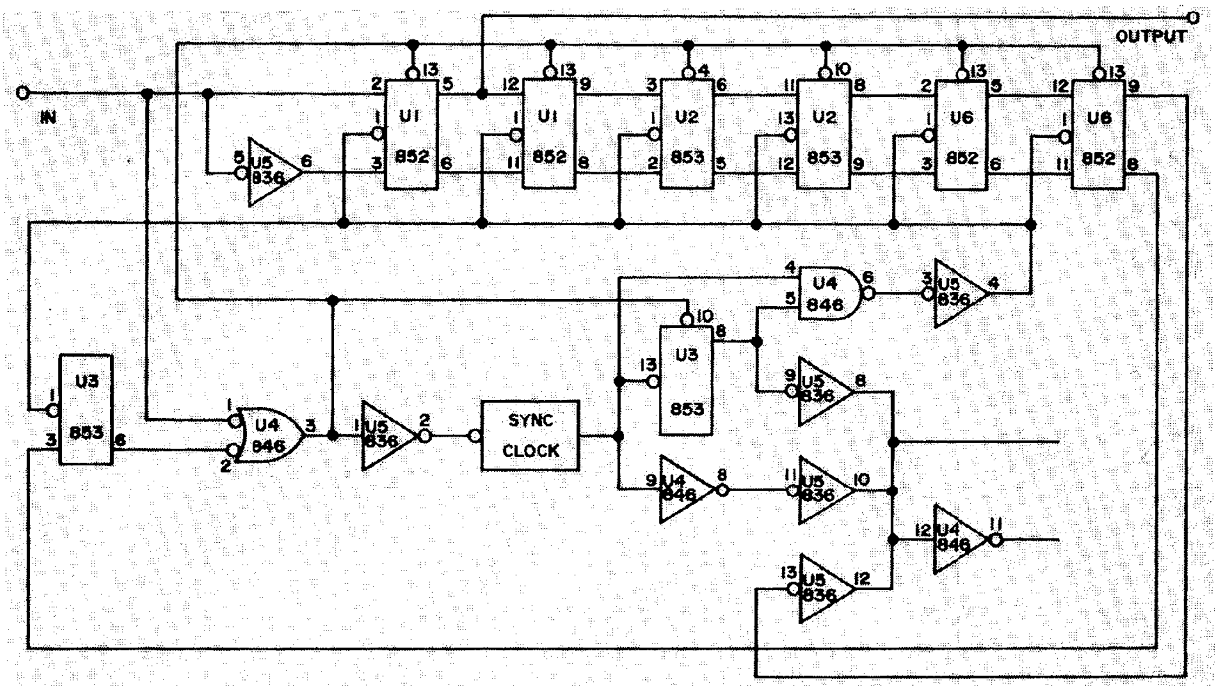


Fig. 5. Basic stunt box.

signals and to transmit perfectly clean signals from your aging keyboard!

The Stunt Box

The stunt box is a relatively simple expansion of the repeater, requiring only a few more parts and the rerouting of a few wires. Comparing the stunt box (Fig. 5) and the repeater, (Fig. 2), we find three differences: First, the output flip-flop is now the first stage of a six-stage shift register; when the first signal element is loaded into U1 pin 5 the start element moves to U1 pin 9, and so on until after the sixth sample, when the start element is present at U6 pin 9 and the five signal elements are stored in the first five stages of the register.

Second, instead of counting out seven sample pulses with a counter, we now wait for the start element to move into the last stage of the register, causing U6 pin 8 and U3 pin 8 to go high. Now, as before, the seventh pulse samples the stop element and resets the whole works.

Third, 11 ms after the sixth pulse we find that U5 pin 9, U5 pin 11, and U5 pin 13 are all low, allowing U5 pin 8, 10, and 12, and U4 pin 12 to go high and forcing U4 pin 11 low. Thus, we get both a positive and a negative strobe pulse which occur once each character, and at a time when the entire character code is stored in the register. This is all the information we need to decode a character.

A simple stunt box decoder is shown in Fig. 6. This decoder is set up to respond to the two character sequence ZB. When the positive strobe pulse occurs the two flip-flops sample the *nand* gate outputs U7 pin 6 and U7 pin 8. If the character in the register is anything other than a Z, U7 pin 6 will be high when strobed and U8 pin 6 will remain low. A Z forces U7 pin 6 low and U8 pin 6 goes high after the strobe pulse. If the next character is anything other than a B, U7 pin 8 and U7 pin 6 will be high at the time of the strobe pulse and U8 pin 8 will remain low. If, however, the character after the Z is a B, U7 pin 8 will go low and U8 pin 8 will go high and remain high until the next character is received. Using this decoder as a starting point, much more complex decoders can be built to respond to any number of character sequences of any length and used to set and reset latches to turn your printer, tape unit, or coffee pot on and off on command.

The Speed Converter

Now that we have taken a 60 wpm TTY signal and shifted it into a register where we have it temporarily stored, all that

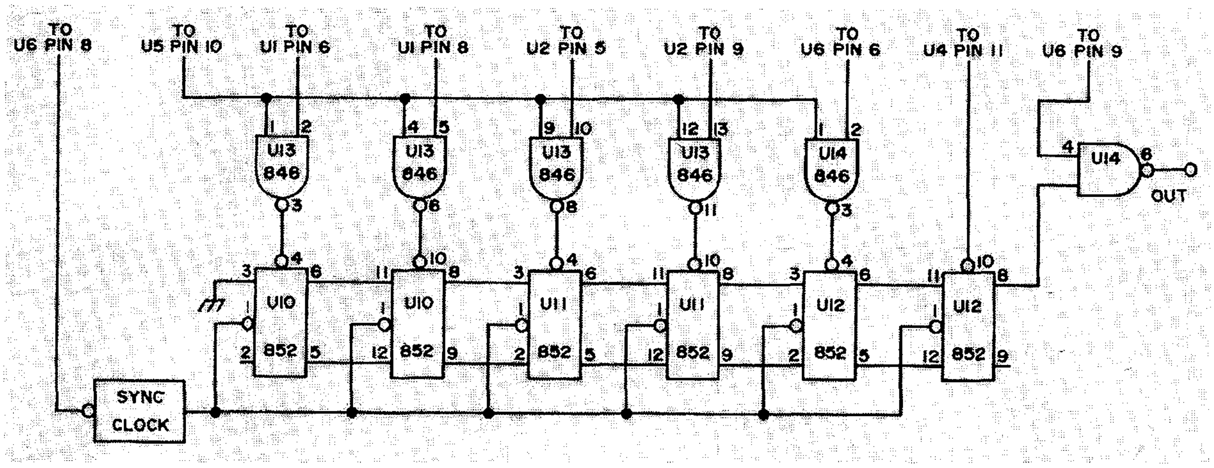


Fig. 6. Simple stunt box decoder.

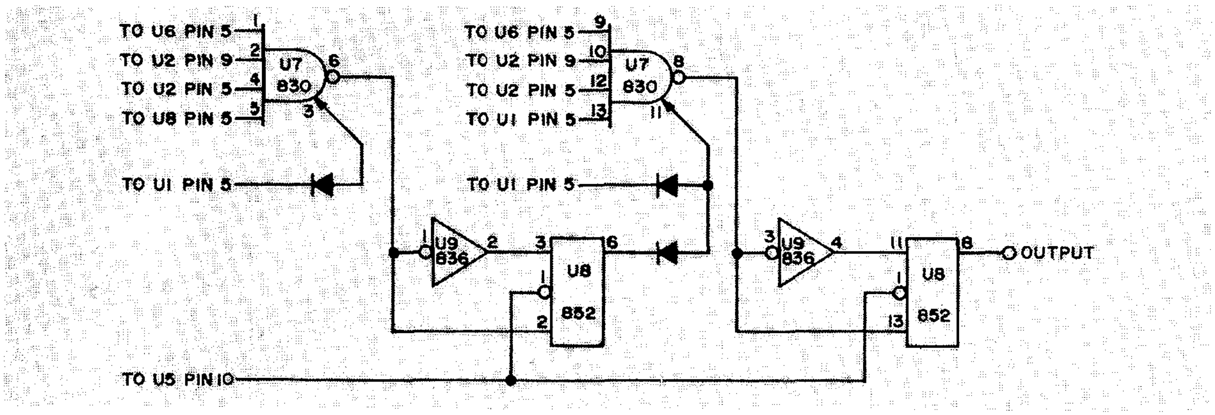


Fig. 7. Speed converter adapter for stunt box.

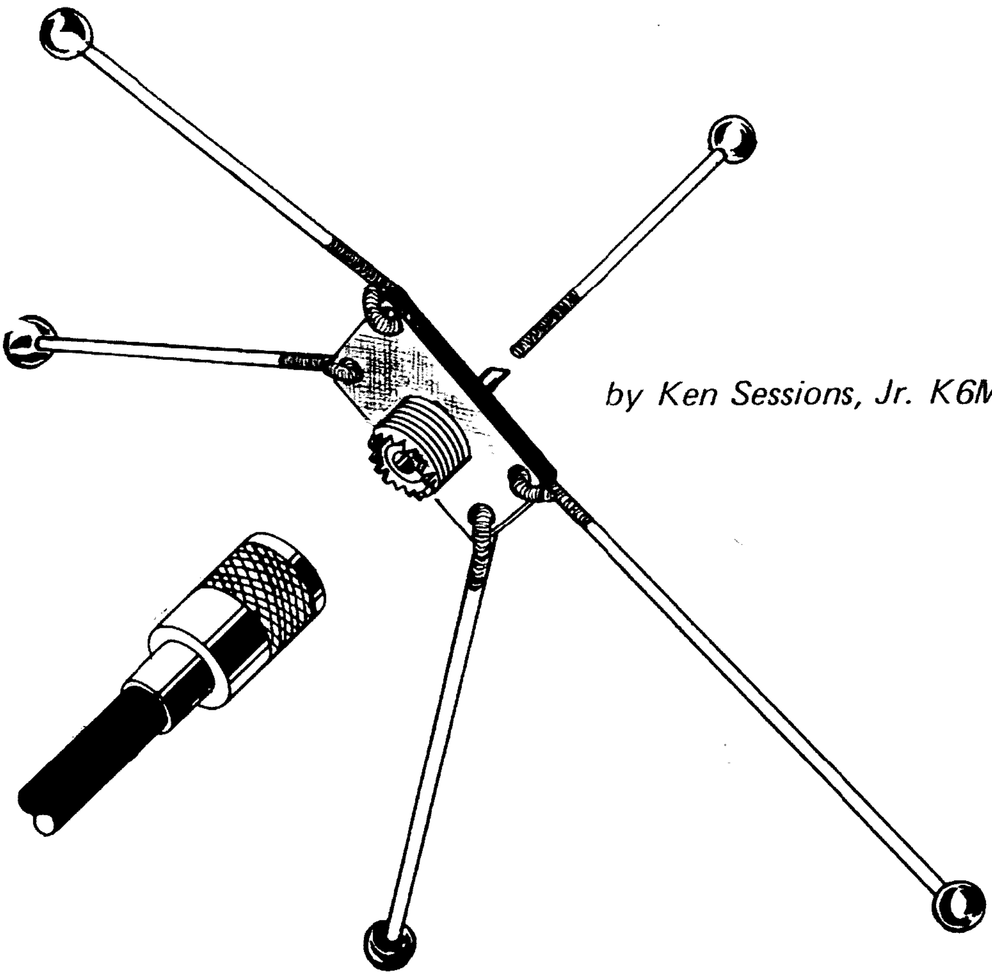
remains to be done to make it print on a 100 wpm machine is to load it into another resister, in parallel form, and shift it out to the printer with shift pulses that occur every 13.5 ms. The hardware required to accomplish this is shown in Fig. 7.

Before a character is received U6 pin 8 and the input to the 74.2 Hz synchronous clock are low, the clock is running, and the register is shifting. But since the input to the first stage of the resister, U10 pin 3, is held low and the output to the printer, U14 pin 6, remains high, or marking. When the start element of a character shifts into the last stage of the first register U6 pin 8 goes high and the 74.2 Hz clock stops. When the strobe pulse occurs, 11 ms later, U5 pin 10 goes high, loading the five signal elements into the first five stages of the second register. At the same time U4 pin 11 goes low, forcing a space, or start element, into the last stage of the second register. The output to the printer remains in the marking condition, however, since U6 pin 9 is holding U14 pin 4 and the input to the output *nand* gate at a low level. When the stop element has been sampled and the first register resets, U6 pin 9 goes high, allowing the start element in the last stage of the second register to appear at the output to the printer. At the same time U6 pin 8 goes low, restarting the 74.2 Hz clock and allowing the character to shift out of the register to the printer. As the character shifts out the register fills up with marks so that 13.5 ms after the last signal element is sent to the printer the output goes to a marking condition and stays there until the next character arrives.

To convert the 100 wpm output of the keyboard to a 60 wpm input for your keyer it is only necessary to reverse the input and output leads of the converter and switch the clock frequencies from 91 Hz and 74.2 Hz to 148.4 Hz and 45.5 Hz. Of course, the keyboard may only be operated at typing speeds up to 60 wpm, but that shouldn't cramp the typing style of too many of us!

. . .K5ZBA■

The Coathanger Groundplane



by Ken Sessions, Jr. K6MVH

For UHF and VHF applications in particular, the groundplane is perhaps the most utilitarian of all antenna types. It is simple to build and offers effective performance for both receiving and transmitting. The most economical of the groundplanes is the "coathanger" type, where the elements are cut from wire coathangers or some other stiff conductor (such as 10 AWG type TW copper wire). With a little imagination on the part of the builder, the coathanger groundplane can be made into a very professional-looking antenna.

To build up a quickie 2 meter groundplane, you'll need five coathangers, five toy plastic beads, a chassis-mounting UHF connector, and some silicone grease.

The first step is cutting. Refer to the cutting chart to determine the lengths of

the radials and the radiator, then straighten the wires and cut accordingly.

When the elements have all been cut to length, sand the protective coating from the coathanger wires for ¾ in. at one end of each piece. Most coathangers are coated with a heavy varnish-like compound to retard rust and corrosion. The sanding operation removes this coating and prepares the wire to accept solder.

The beads will be affixed to the unsanded ends of the elements. The beads offer an added measure of safety and give a professional appearance to the antenna. To attach the beads, heat the unsanded end of a wire on the kitchen stove for a few seconds; then, while the conductor is still very hot, press the bead down firmly over the wire end. The heat melts the plastic of the bead so that the stiff wire bores its own hole. Now, as the wire and bead cool, the plastic bead hardens and becomes securely attached to the end of the element.

The four screw holes in the chassis UHF connector will be the "solder lugs" for the radials. Using a pair of long-nose pliers, bend a "U" in the sanded end of each of the four longer pieces. (The shorter piece is the upright radiator, and requires no bend.) Allow no more than ½ in. for each bend, and be sure to keep each piece the same length.

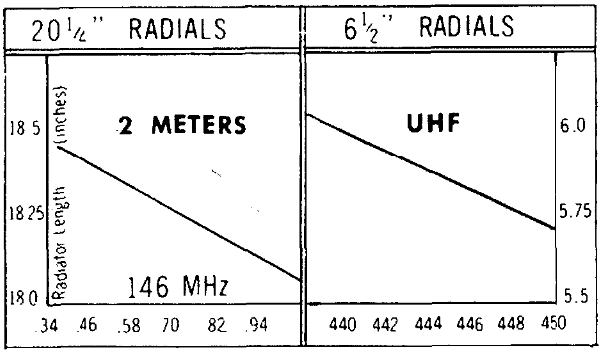
Hook each bend into the UHF connector as shown in the sketch on the preceding page, then compress the joints with pliers. Try to keep each radial positioned so that it maintains a 90-degree interval from adjacent elements.

Before soldering, adjust the positions of the radials precisely so that a symmetrical cross is formed by looking directly down onto the antenna from the top. Then solder all connections with a heavy iron or gun. The chassis connector requires a considerable amount of heat to keep the solder flowing, and insufficient heat will mean cold solder joints.

When the radials have been soldered, insert the shorter upright piece into the "center conductor" soldering point of the chassis connector. Twirl the radiator in the tube as you solder to make sure it is tinned completely, but don't allow excess solder to build up to the point where it exudes onto the dielectric. The characteristic impedance of the connector is determined by the dielectric material as well as the radial distance from the center conductor to the shield. If this distance is shortened in any way – as from a blob of solder – the characteristic impedance will be lowered and a mismatch will result.

When the joints have cooled, carefully bend the radials downward about 30° from the horizontal. This will lower the radiation angle of the antenna and will result in a better match for a 50Ω input impedance. Spread a generous amount of silicone grease over all connections to prevent corrosion and minimize the chance for water entry.

That's all there is to it; the antenna is ready to use. And in appearance, it's "just like downtown."



If you're thinking of building up this antenna to use in conjunction with a repeater or remote installation, there's one other trick of interest: Mount the thing upside down! Of course, this type of an installation would not be beneficial at all in run-of-the-mill applications, but it could mean the difference between "hearing" and "hearing nothing" on a mountaintop.

The groundplane characteristically has a very high angle of radiation. This problem is not too evident when the antenna is put into service in the lowlands; but when it is part of a mountaintop station, a high angle of radiation gets less and less tolerable. By mounting the groundplane so that the vertical radiator is suspended, the angle of radiation can be put to work *for* you. Try it! It really works!

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STUDY GUIDE GENERAL CLASS LICENSE

Part VII Power and How to Get It

To operate any radio equipment, whether transmitting or receiving, you've got to have power – and it has to be just the right kind. While receivers can get by with a mere thimbleful of energy, transmitters have healthy appetites. The more potent the signal output, the heftier the rig's gulps of power.

So every different kind of equipment has its own power requirements, and the result is that the art of providing the proper power structure to keep a station simmering isn't as simple as might be expected.

Like all other aspects of radio theory, the FCC expects its licensees to be familiar, with the theory of power supplies, and devotes a number of questions in the General examination to that subject. This time around in our study course, we're going to take a look at them. The specific questions are numbers 2, 10, 12, 18, 26, 28, and 34 on the official study list:

2. Of what use is a bleeder resistor in amateur equipment?

10. What is meant by the ripple frequency of an ac power supply voltage?

12. How does a zener diode operate and of what use is it in amateur equipment?

18. How do electrolytic capacitors operate and why are they widely used in power supply circuitry?

26. Why is a centertap return connection employed on the secondary of a transmitting tube's filament transformer?

28. Describe ways of equalizing the reverse voltage drops across series connected silicon diodes.

34. How does an ac power supply produce a dc voltage? Distinguish between a choke-input and a capacitor-input filter and compare their operating characteristics. What is dynamic regulation and how can it be improved? How do the output voltages of a full-wave centertapped and a full-wave bridge rectifier compare?

Following our usual practice, we'll recast these questions into more general ones which will, we hope, cover the subject more completely.

For openers, we'll try to learn "How is ac converted to dc?". We can then address ourselves to the question, "How is our new dc made usable?" and find out how filters operate. Next, we will ask "How is power supply performance rated?" to gain some definitions of necessary terms. Finally, we'll see "How can power supply performance be improved?" and look into methods of regulating voltage and current.

How is AC Converted to DC? Most electronic equipment operates from direct current. FCC rules require "pure dc" for the plate supply of any transmitter operating below the VHF region, and good operating practice requires it up into the microwaves. Yet dc of the proper voltage and power level doesn't come out of the wall outlet on demand. We must have circuits which take the ordinary ac available in any home, and convert it to the required dc. Such circuits are known as "power supplies," and they're the subject of our discussions in this installment.

In general, any power supply is composed of three distinct functions as shown in the block diagram of Fig. 1. These are (1) the voltage-determining portion, (2) the rectification portion, and (3) the filter. Operation of each depends upon the characteristics of the other two, yet many choices are possible for each block of the circuit.

The voltage-determining portion usually consists of one or more transformers which step the household ac from its 115 or 230V value up or down as required. For most power supplies, a step up is necessary, although filament supplies normally involve a step down.

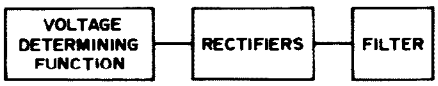


Fig. 1. Any power supply must include these three functions. Voltage is usually determined by transformer, which may step input ac either up or down. Vacuum tubes require step up, usually, while transistors require step down. Rectifiers change ac output of voltage-determining function into pulsating dc, and filter smooths out the ripple in the rectifier output to produce "pure dc."

The amount of step-up required depends both upon the desired output voltage and the rectifier arrangement, as well as upon the type of filter employed. The transformer itself, however, is essentially the same as those employed for impedance matching and examined in our previous installment, except that power transformers need operate at only one frequency and so are somewhat simpler to design.

The stepped-up ac goes from the voltage-determining block to the rectifiers, and there's where wide choice comes into play. At least three different rectifier arrangements are in common use with single-phase power supplies; all three are shown in Fig. 2.

The half-wave rectifier is the simplest of the three, but is also the least efficient since it throws away half the ac cycle. This circuit is seldom used for circuits which are intended to deliver any appreciable amount of power, although it finds frequent application in bias supplies and other low-current uses.

The centertapped full-wave rectifier is probably the most commonly used circuit. While it requires a centertapped transformer capable of supplying twice the voltage desired at the output, it makes full use of the input ac cycle and places no severe demands upon any circuit components. When virtually all rectification was accomplished by vacuum tubes or mercury-vapor bottles, this circuit was almost universal.

The full-wave bridge rectifier, like the

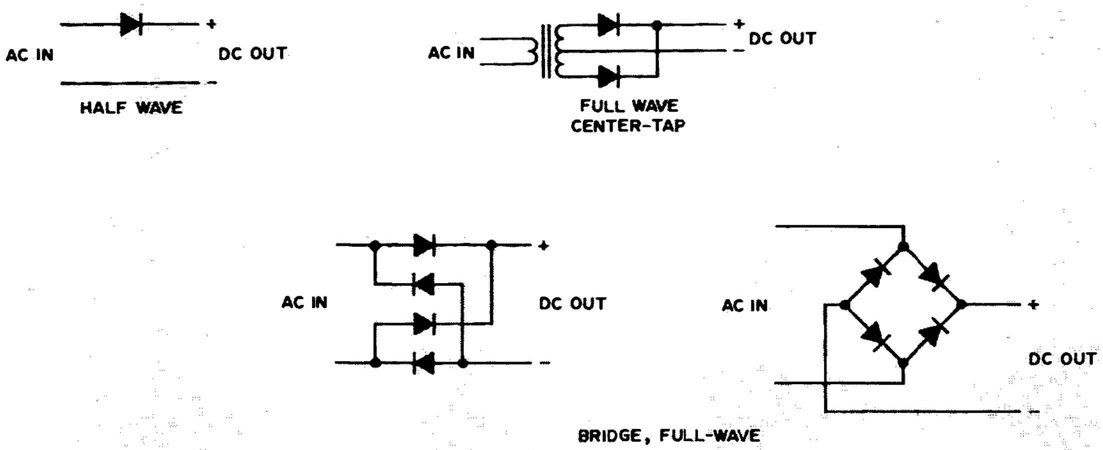


Fig. 2. These three circuits represent the only rectifier hookups in common use. Half-wave circuit is used only in ac/dc receivers and extremely lightweight gear. Full-wave centertap circuit is functionally just two half-wave circuits back to back, with transformer providing two-phase ac. Bridge circuit uses four diodes, but steers ac input through to output without need of transformer while retaining full-wave advantages.

centertapped circuit, makes full use of the input ac cycle, but with some rather significant differences. The centertapped circuit is, essentially, just a pair of half-wave circuits of opposite phase operating in parallel. The bridge, however, is a completely different kind of circuit, in that its diodes "steer" the incoming ac in the proper direction so that it always comes out at the same output terminal regardless of the input terminal it entered.

Because of this steering effect, the bridge does not require a double-voltage transformer. If used with the same transformer as a centertap full-wave circuit, the bridge will produce twice the output voltage – and this arrangement is often used to produce a 100W power supply operating from ordinary TV-replacement power transformers.

The bridge circuit does, however, place additional requirements upon some of its diodes, which limit its attractiveness if tube-type diodes are to be used. Full output voltage appears between cathodes and filaments of the "off" diodes; most tube-type diodes are not rated for this stress. With solid-state rectifiers, though, the bridge is not limited by this difficulty – and since the advent of silicon rectifiers, the bridge circuit has gained wide popularity.

All three of these rectifier circuits involve diodes, which are electronic one-way valves. Diodes come in three major flavors, with subflavors in some cases. They may be high-vacuum tubes, of either high, medium, or low impedance; mercury-vapor tubes; or solid state, such as silicon, germanium, or selenium stacks.

Tubes are used when extremely high reverse voltages are involved, but in many new designs only solid-state diodes are employed.

Tubes are usually rated for maximum direct current per plate, maximum peak current per plate, maximum peak inverse plate voltage, and maximum rms supply voltage per plate.

Solid-state diodes may be rated for peak inverse voltage (PIV), rms supply or input voltage, average forward current, peak one-cycle surge current, peak forward current, forward voltage drop, and thermal resistance. Of all these, the most important are those which correspond to the tube ratings: PIV, average forward current, and peak one-cycle surge current.

PIV is the maximum voltage which can be applied "in reverse" to the diode before it breaks down and permits current flow "against the stream"; when exceeded instant destruction of the diode usually results. If the diode is connected to a capacitor, diode PIV should be at least twice the peak value of applied ac voltage; otherwise, PIV should be at least equal the peak of the applied ac.

Two or more diodes can be connected in series to increase their PIV ratings, provided that equalizing resistors are connected in parallel with each as shown in Fig. 3. These resistors assure that each

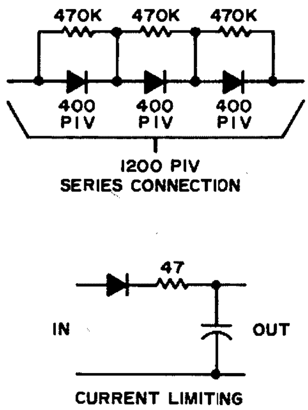


Fig. 3. Semiconductor diodes require their own special tricks. To extend PIV of diodes, two or more can be connected in series, but resistors must be paralleled with each to assure that back voltage divides equally among all units rather than piling up on unit with highest reverse resistance. When capacitor-input filters are used, current through diode must be limited by low-value resistor, to stay within one-cycle surge ratings of 10 to 50A. Value of 47Ω at 1W usually suffices.

diode gets only its share of the applied voltage; otherwise, most of the voltage would appear across the diode with highest back resistance.

Average forward current is the maximum current which the diode can pass without overheating, on a steady basis.

Peak one-cycle surge current, usually at least 10 times greater than average current,

is the maximum current which can be tolerated on a "one-time" basis without destruction of the unit. Surges occur each time the power supply is turned on, as the filter capacitors charge, and if this rating is ignored with semiconductors, diodes will behave like expensive (and rapid) fuses every time.

While surge current limitations appear more often in connection with solid-state diodes, they apply to all rectifiers. However, tube-type diodes normally have such high internal resistance that they automatically limit themselves to surge currents too small to cause damage. Solid-state diodes, on the other hand, have much less internal resistance and at the same time are much more prone to damage by surges. For this reason a current-limiting resistor capable of holding maximum current within the "surge" rating even in case of a dead short should always be included in series with solid-state diodes as shown in Fig. 3.

Regardless of the type of rectifier used, the output of the rectification part of the power supply is dc rather than ac. This dc is, however, not yet usable because it is "pulsating" rather than "pure." The waveform of the dc at this stage, were it to be fed into a resistive load, would look like Fig. 4 which shows both half-wave and full-wave rectifier-output waveforms. The continual change in level of this power makes it unusable for our purposes; that's why our power supply contains the final block, the filter.

How is Our New DC Made Usable? When our dc emerges from the rectifier circuit, it's pulsating as shown in Fig. 4,

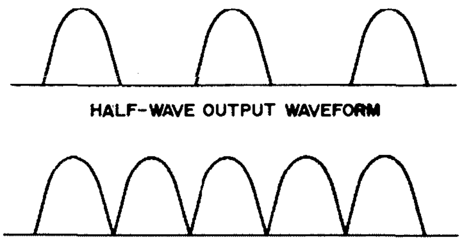


Fig. 4. These waveforms are produced by the rectifier circuits shown in Fig. 2. Half-wave circuit "wastes" half the input ac cycle; full-wave circuit makes use of both halves to produce higher output voltage, and also produces double the ripple frequency which makes filtering easier.

and cannot be used. The filter circuit evens out the voltage and current waveforms, turning it into "pure" dc required by FCC regulations.

Filters are composed of capacitors and inductors, with the capacitors being connected in parallel with the output of the power suply, and the inductors in series. This arrangement makes possible two different layouts for the filter's input circuit, as shown in Fig. 5. Either the series

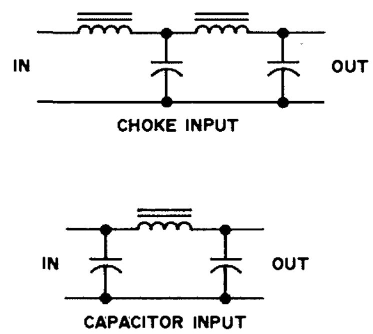


Fig. 5. These schematics show the two types of filter circuits most often encountered in ham equipment. Choke-input filter produces better regulation but lower output voltage; capacitor-input filter is harder on diodes and transformer but produces higher output voltage. Capacitor input is widely used at low power levels but choke input is almost exclusively employed at high power.

inductor can be the first component encountered at the input or the parallel capacitor can be first. If the inductor appears first, the circuit is known as a "choke-input" filter, while if the capacitor appears first, the filter is called a "capacitor-input" type.

Choke-input and capacitor-input filters have very different characteristics, caused by the differences between inductors and capacitors. Compared to a choke-input filter, a capacitor-input filter will produce a higher output voltage at light current drains, but with poorer voltage regulation since at heavy current loads, output voltage for both types is similar. The capacitor-input filter requires higher voltage ratings for the rectifier diodes, and imposes a heavier current load on the transformer.

Because of these differences, capacitor-input filters are most often used for re-

ceivers and test equipment, where current loads are not likely to vary widely. Transmitters, on the other hand, use choke-input filter circuits more frequently.

The differences between the choke-input filter actions and the actions of the capacitor-input filter are best understood by looking at the waveforms which show what happens inside the power suply during a single cycle of ac input. The waveforms for a capacitor-input filter are shown in Fig. 6. Full-wave rectification is assumed; half-wave rectification merely emphasizes the differences.

Waveform A in Fig. 6 merely shows what the full-wave ac would look like across a resistor, in the absence of any filter.

When the filter capacitor is connected, with a moderate load current being drawn,

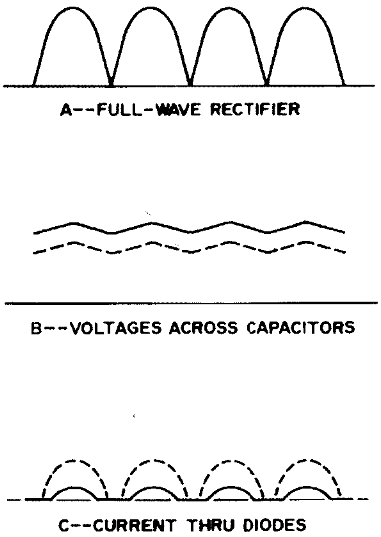


Fig. 6. Waveforms encountered in capacitor-input filter with both light (solid) and heavy (dotted) load currents. Note how both voltage and current waveforms vary as load current is changed. With zero load current and perfect capacitors, output voltage would be pure dc equal to peak voltage of rectified signal; with actual capacitors and light load current, output is slightly less than peak.

the voltage across the capacitor follows waveform B; from point B1 to B2 the capacitor is charging, and from B2 to B3 it is discharging. Current through the diodes, however, flows only during the time from B1 to B2 because the transformer voltage is less than the capacitor voltage for the

remainder of the cycle, so the rectifier current waveform follows that shown as C.

With very little current being drawn, the discharge portion of the capacitor-voltage waveform (that from B2 to B3) becomes almost horizontal, and the entire waveform shown at B rises toward the peak of the rectified waveform. Waveform C then becomes smaller and smaller, until it disappears at the limit of zero load current, with output voltage becoming equal to ac peak input voltage.

Under heavy current load, the discharge curve (B2 to B3) steepens, pulling the entire waveform toward the "zero" line and increasing the amplitude and duration of the pulses in waveform C. These current pulses eventually become so large as to limit the performance of the power supply.

The ac component remaining in waveform B is known as the "ripple" frequency of the power supply, and is determined by the timing between voltage peaks in waveform A. In a half-wave circuit, the ripple frequency is the same as the frequency of the input ac, while in a full-wave circuit, the ripple frequency is twice that of the ac

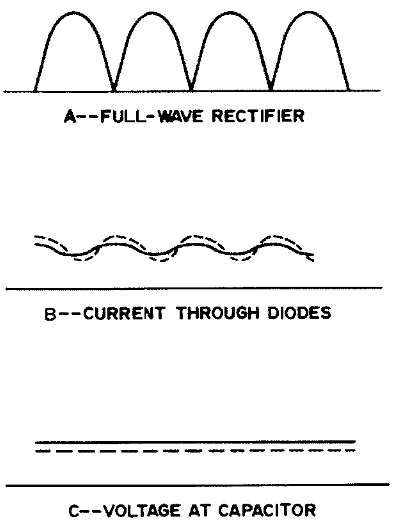


Fig. 7. Waveforms found in choke-input filter are very different from those of capacitor-input circuit. Input choke maintains current through diodes essentially constant, so capacitor voltage does not vary widely between light (solid) and heavy (dashed) load conditions. With half-wave rectifier, output voltage would be only half as great as with full-wave; this difference does not show up nearly so much with capacitor-input filters.

input. Amplitude of the ripple is determined by the peak-to-peak excursions of waveform B, and so depends upon the current being drawn from a capacitor-input filter – the less the current drain, the lower the ripple amplitude!

In the capacitor-input filter, then, we have seen that current is drawn through the rectifier citcuit only when the transformer voltage exceeds the capacitor voltage, and as a result flows in pulses.

The choke-input filter's waveforms are shown in Fig. 7. Again, waveform A merely repeats the full-wave ac waveform in the absence of any filter.

Since the inductance of the choke acts to oppose any change in current flow through the choke, it will tend to keep current flow out of the rectifier circuit steady, as shown in waveform B. This in turn provides a steady flow of current into the rest of the filter circuit, which produces a steady level of voltage across the output, as shown at waveform C.

Waveforms B and C are obtainable only with "perfect" chokes, and in practice, some ripple will be present just as in the capacitor input filter waveforms. This ripple is due to changes in the inductance of the choke as current flow through it changes.

Whether the choke or the capacitor appears first, the combination of a choke in series and a capacitor in parallel is called a "filter section" and most practical power supplies use at least two sections of filtering in order to reduce ripple to the desired low values. Occasionally, in receivers, the choke will be omitted from the second section, to produce a "pi-section" filter composed of two capacitors separated by a choke.

In addition to the chokes and capacitors, every power supply should include a bleeder resistor across its output.

One of the most important purposes so far as the individual user of the equipment is concerned is safety; the bleeder provides a path for eventual discharge of the filter capacitors, so that they cannot retain their possibly lethal charge for indefinite times. This, though important for safety, is not the primary reason for including the bleeder resistor, however – mere danger does not justify the expense of the components, nor the power required by their presence.

The electrical purpose of the bleeder resistor is to establish a minimum load upon the power supply, which will maintain current flow through the filter circuit at or above a certain critical level. This is necessary because the inductance of the chokes in the filter varies with the current through them; by maintaining a minimum current at all times, smaller values of inductance may be used.

Whether the filter uses choke or capacitor input, both the inductance and capacitance values required are very large in comparison to those required for radio-frequency circuits. Inductance values are usually measured in henrys rather than millihenrys or microhenrys, and capacitors are in the range from 2 to 200 microfarads. These large reactive elements are necessary both because the ripple frequency to be filtered out is low (120 Hz is the highest ripple frequency normally encountered in power supplies operating from commercial ac power), and the energy drain is high, which forces the circuit to operate at a low impedance level.

To achieve the high inductance values, "swinging" chokes are often used, particularly in choke-input filters. When a swinging choke is used, the value of the bleeder resistor becomes a critical item in filter design.

A swinging choke differs from an ordinary inductor in that it has a smaller-than-normal air gap in its core. This smaller air gap permits the choke's inductance to fluctuate as current through its winding varies; with low current, inductance is high, and as current increases, inductance drops. Typical swinging chokes vary over a 10-to-1 inductance range through their rated current range. Only enough copper and iron are necessary to provide the minimum inductance, in this design, which gets by because high inductance is necessary only at low current levels.

No such trick is available to help cut the cost of capacitors – but fortunately a special type of capacitor exists, which finds wide use in power supply circuits. Like all

capacitors, it consists of two conductors separated by an insulating dielectric, but in this case the dielectric is a film of metal oxide formed chemically on the surface of one of the conductors, while the other conductor is the chemical solution which forms the oxide layer. Such a unit is called an electrolytic capacitor.

An electrolytic capacitor provides more capacitance in a given space and at a lower cost per microfarad than any other type, but it has several disadvantages which partially cancel this advantage. Since the capacitor is literally formed by the action of direct current upon a chemical solution, it can be used only on dc; any ac in the circuit must be kept small in relation to the dc present, or the capacitor will be shorted out. All electrolytics depend upon internal moisture for their action, even though they may be called "dry." The "dry" means merely that all the moisture stays inside, in contrast to early designs called "wet" which had grave tendencies to drip electrolyte all over everything.

In addition, the highest voltage rating seldom exceeds 500V peak, and any voltage in excess of this can cause instant punch-through. The resulting arc does two things immediately; it dries out the capacitor and vaporizes the chemical. A few milliseconds later, the former capacitor is a mess of sticky goo all over the interior of a once-clean chassis.

Unlike other capacitors, electrolytics have rather high leakage current ratings. This may be as much as 1 mA for every 4 mF of capacitance, but varies widely with temperature, age of the individual capacitor, operating voltage, and many other factors. The need to maintain polarization and the high leakage are the two factors which restrict electrolytics' main applications to power supply filters.

Electrolytics are manufactured in an assortment of voltage ratings from 3V up to 525V (working ratings, with surge voltages of up to 10% higher permissible), and in capacitances from 1,000,000 microfarads (yes, that's one full farad) down to as small as 2 mF. In general, the high capacitance values are obtainable only at low voltage, and vice versa. Typical units

found in most power supplies range from 8 to 50 mF, at 350 to 450V. For low-voltage supplies, typical values might be 1000 mF at 15V.

When voltage is first applied to an electrolytic capacitor, leakage current is very high. The current "forms" the dielectric film, however, and leakage drops rapidly. This ability to form a new dielectric gives this capacitor a "self-healing" characteristic in case of momentary overvoltage, provided that the overvoltage doesn't start an arc which prevents the healing action.

Electrolytics are manufactured by wrapping an aluminum foil sheet and an electrolyte-soaked cathode material together, and applying dc with carefully limited current until the dielectric film is formed. The film tends to dissolve when the capacitor is idle, but usually re-forms when power is applied unless the power surge is too great and causes overheating. For this reason, it's advisable to keep power supplies in operation intermittently when equipment is to be shut down for extended periods of time, or alternatively to carefully re-form the filter capacitors before applying full voltage again.

How is Power-Supply Performance Rated? Performance of a power supply, like that of any other item of electronic equipment, can be measured only by comparison to known standards. The process of making such comparisons amounts to "rating" the performance of the supply.

Some of the obvious factors involved in such a rating are the output voltage and output current available from the supply, as well as the input voltage and current required. Not so obvious, however, are some nevertheless important factors, such as "regulation" and "ripple content" of the supply's output.

Let's start this discussion by defining our terms. Then we'll be in a position to find out how to fit values into the phrases, or interpret them should we encounter a statement such as, "This circuit offers a high degree of regulation but cannot tolerate input voltage variations."

One of the major terms,– and unfortunately, one with many contradictory meanings – is "regulation." All of its

meanings deal with *changes* of output voltage from a given power supply, but that's about all they have in common. A highly regulated supply maintains fairly constant output voltage, and a supply with poor regulation has an output voltage which can be expected to vary widely – but just what makes the output vary isn't too clearly defined.

One of the meanings often attached to "regulation" is a measure of the change in output voltage as the input ac voltage is varied. For instance, if a supply is designed to operate with 115V ac input and produces 2

One of the meanings often attached to "regulation" is a measure of the change in output voltage as the input ac voltage is varied. For instance, if a supply is designed to operate with 115V ac input and produces 250V dc output under its design conditions, and still produces approximately 250V dc, even when input voltage goes down to 100 or climbs to 130, that supply has good regulation in this sense.

A more commonly intended meaning for "regulation" deals with changes in output voltage as output current is varied, with input voltage held costant. Our well-regulated (for input variations) supply of the previous paragraph might produce its 250V dc output at a load current of 100 mA, yet drop to 200V at a current of 200 mA and climb to 300V dc if current drain is reduced to 50 mA. In this case, its regulation (in this sense) would be rather poor.

That's what we meant by "contradictory meanings," since we've given an example of a well-regulated supply (for input variations) which is poorly regulated (for load changes).

Compounding the situation is the addition of adjectives to the word "regulation," to create such phrases as "static regulation" and "dynamic regulation."

While the phrase "dynamic regulation" appears in the FCC study list as something you are expected to be able to define, we have not been able to find any mention of this phrase in the standard engineering texts and references, such as Terman's "Electronic and Radio Engineering," Eastman's "Fundamentals of Vacuum Tubes," the "Radiotron Designer's Handbook," "Electronic Designer's Handbook" by Landee, Davis, and Albrecht, or "Reference Data for Radio Engineers," all of which have extensive sections on power spply design and measurements. Neither could we find the phrase in three separate editions of the ARRL "Radio Amateur's Handbook," or two editions of the Editors and Engineers' "Radio Handbook." This makes it a bit difficult to provide a guaranteed definition of the phrase!

Some authors have attempted to separate the sometimes-contradictory meanings of "regulation" by attaching "static" to indicate changes caused by changes in input voltage, and "dynamic" to indicate changes due to variations in current drawn. The idea is that input-voltage variations are likely to occur more slowly, and to persist longer, than are current variations caused by circuit operation, thus justifying their being called "static" and using "dynamic" for the more rapidly varying current changes.

This does not, however, remove all confusion, because the idea of a "static change" is in itself a contradiction. And at least a few stubborn souls have reversed these conventions as well, using "dynamic" to mean input-voltage changes and "static" for changes of load.

Another meaning possible for "dynamic regulation" involves the reaction of the power supply to a rapidly changing load such as that produced by a class B modulator or an SSB final. Many supplies which exhibit good regulation under conventional testing go wild under such rapidly changing loads, because they are unable to keep up with the changes. In this context, *static* regulation would be that measured by imposing various loads for relatively long times while making measurements, and *dynamic* regulation would be that shown in action under loads which were continually changing – and this is *probably* the context meant by the FCC.

While we're compounding the confusion, it must be brought out that "regulation" as a general property of a power supply is one thing, confusing though it

may be – but "regulation" as a factor to be measured is something else. In the U.S., engineers measure power supply regulation in percent, and the regulation percentage is defined as the ratio between the difference of unloaded and loaded voltage, and the loaded voltage, all times 100. That is, a supply which delivers 250V without load, and 225V when loaded, has a regulation percentage of (250-225)/225, times 100, or 25/225 times 100, or 11.1%.

Regulation percentage doesn't necessarily mean the same thing everywhere. In other countries, it's sometimes figured as the difference over the *no-load* voltage, which would make that same example come out to 10% rather than 11.1, and occasionally it's figured as the loaded voltage over the no-load value, or 90%!

In short, about the only thing you can be certain of when the word "regulation" is used is that changes in the output voltage of a power supply are being discussed.

Hand-in-hand with regulation, but fortunately with much more precise meaning, is the term "output impedance" as applied to a power supply. The output impedance of a power supply is defined as the no-load voltage minus full-load voltage, divided by full-load current, and is expressed in ohms. If the power supply we used as an example to show the confusion possible with "regulation percentage" achieved that performance with a 100 mA current drain at full load, its output impedance would be 250–225 or 25V divided by 0.1A, or 250Ω.

The importance of the "output impedance" is that the power supply acts to any external circuit just like a short circuit in series with a resistor of the corresponding value. If 10 mA is drawn through a 250Ω resistor, the resulting voltage drop is 2.5V. Similarly, if 10 mA is taken from our example supply, the voltage should drop 2.5V from its no-load value, or to 247.5V.

Output impedance is especially important with regard to both "static" and "dynamic" regulation in the final context we examined. In both cases, good regulation demands low output impedance – well below 100Ω in most cases.

"Ripple frequency" is a term we've already met, as is "ripple amplitude." Ripple amplitude is usually specified as a percentage of ripple, which is the ratio of the peak-to-peak value of the ripple component only compared to the average value of the dc output voltage. A more meaningful way to rate ripple is directly in terms of peak-to-peak ripple voltage and frequency. In some cases, any ripple voltage over a microvolt or so is too much; in others, as much as 25 to 30V peak-to-peak of ripple may be acceptable. It all depends on what the resulting dc is to be used for.

Usual values of ripple percentage range from 0.1 to 5%; most charts for filter design appearing in the handbooks are calculated for 5% ripple, but if two sections of filtering are used the result will be 5% of 5%, or 1/4 of 1%, ripple.

Now that we have our terms defined, we can turn our attention to the performance factors to which they refer. The major factor is, as one might expect since it is surrounded by the most confusion, "regulation." Ideally, a power supply should produce an output voltage which is constant, regardless of changes in either input voltage or load. This would be perfect regulation, or "zero" output impedance, and in general it cannot be achieved. But it *can* be attained over a surprisingly wide range of load currents, by use of some special circuitry we'll examine shortly.

Unless special regulator circuits or components are used, however, the regulation of the supply must necessarily be less than perfect. Just how much less depends upon the entire design of the supply. A choke-input filter provides better regulation over its range of operating current than does a capacitor-input one, but requires a higher-voltage transformer to achieve the same output voltage. Large filter capacitors produce better dynamic regulation than do small ones (it's difficult to get too large an output filter capacitor; 500 mF still leaves room for improvement on a 500V supply!) but may produce more loading of the transformer and rectifiers, and at any rate are more costly. A comparison of the output regulation for choke-input and capacitor-input filters appears as Fig. 8, and dynamic regulation of small and large

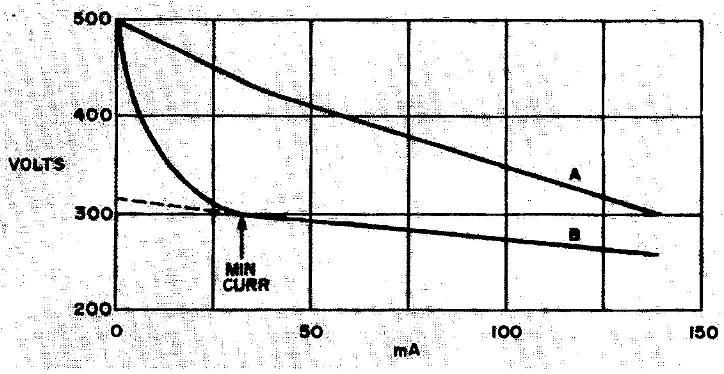


Fig. 8. This graph compares output voltage at various load currents for a typical power supply using (a) capacitor input filtering and (b) choke input filtering, with all other factors held constant. Note that minimum current drain is necessary in order to pull voltage of choke-input filter circuit down into "regulation" region, and that capacitor-input voltage is always higher than that from choke-input circuit.

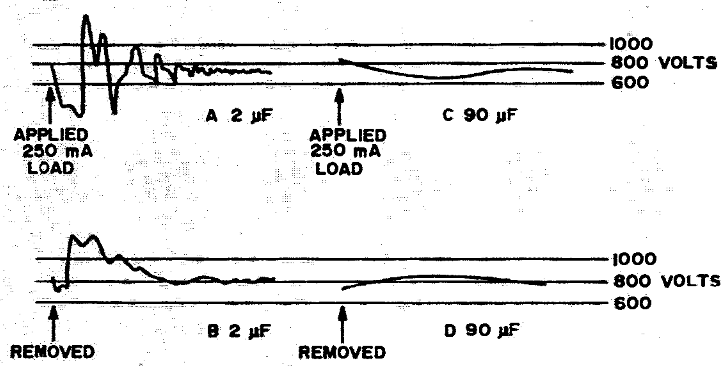
output filter capacitors is illustrated by Fig. 9.

If better performance than that shown in Figs. 8 and 9 is necessary, then a fourth block must be added to Fig. 1 – a regulator circuit.

How Can Power Supply Performance Be Improved? When the utmost in performance is required from a power supply, some form of regulator circuit is usually included between the filter and the output terminals.

Regulator circuits may be as simple as a gas-tube (VR tube or neon bulb), or more complex than many communications receivers. They may regulate the output voltage, the output current, or both. They may guard against changes in output with changes in load, with changes in input voltage, or both. In general, a wide choice of regulators is available.

The simplest voltage regulator for many purposes is a simple neon bulb. The neon gas which provides the bulb's glow has an unusual characteristic of maintaining constant voltage, regardless of current (within limits, of course) through it. In most cases, this is about 55V. A resistor must be



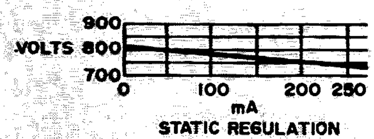


Fig. 9. These waveforms illustrate the meaning of "dynamic regulation" more effectively than could many many words. The graph shows static regulation of the test supply, which remained the same for any value of output filter capacitor. Waveform A shows the transients which appeared on the power lead when full load was suddenly applied with 2 mF output capacitance, and B shows removal of load. C and D are the same, application and removal of full load, but with 90 mF output capacitance.

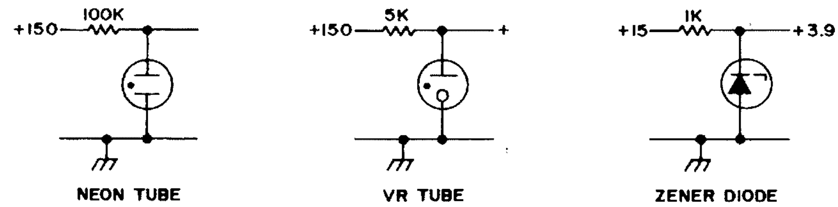


Fig. 10. Three different types of voltage references or simple regulators are shown here, drawn in such a way as to emphasize the similarity of their actions. Each of these produces a voltage which remains relatively constant over a wide range of current levels; so long as their minimum current requirements are met, the voltage is fixed by characteristics of the device. Neon tubes vary in voltage, from 50 to 70V. VR tubes come in specified sizes, as do zener diodes, but the choice is much wider with zeners.

placed in series with the bulb, to limit the current through it to the maximum for which the bulb is rated, as shown in Fig. 10. Output voltage remains constant at the bulb's "maintaining voltage" from zero current drain up to the point at which the current drain through the resistor reduces voltage below the maintaining level and the bulb goes out. So long as the bulb glows, output voltage is regulated.

The familiar VR tube is simply a variation of the same principle. A mixture of argon, neon, and xenon gas is used, and the electrodes in the tube are shaped to permit higher current operation, but the circuit remains the same. VR tubes come in ratings of 75, 90, 105, and 150V, and may be series-connected to produce additional values.

The semiconductor equivalent of the neon bulb or the VR tube is the zener diode. Any silicon diode operated beyond its PIV rating will exhibit the same constant-voltage effect, but zener diodes are especially processed to improve their performance, and to bring the PIV rating down to lower levels. Zener diodes are available to regulate voltages from 3.9 to 150V, and capable of dissipating anywhere from 0.1V to 50W or more of heat while doing so. Like VR tubes, they can be series-connected for "oddball" voltage values, and both VR tubes and zener diodes can be connected in the same series string if need be to achieve some unusual level.

Regulation of these devices is much better than that attained from a bare power supply, but is far from perfect. Output voltage across a VR tube may vary as much as 2V from the full-load to the no-load condition, which is nearly 3% variation for a 75V tube. While this is better than triple the regulation of many bare supplies, it's not good enough for many purposes.

When better performance is required, the electronic regulator becomes necessary. This circuit, in general, combines a voltage reference source, an amplifier, and a control device (series pass vacuum tube or transistor in most cases), to continually compare the output of the power supply with the reference, and to change the output in such a direction as to drive the difference between output and reference toward zero.

Fig. 11 shows the block diagram of a typical simple regulator, while Fig. 12 shows a simplified version of the schematic (omitting such things as rf chokes, parasitic-suppression resistors, bypass capaci-

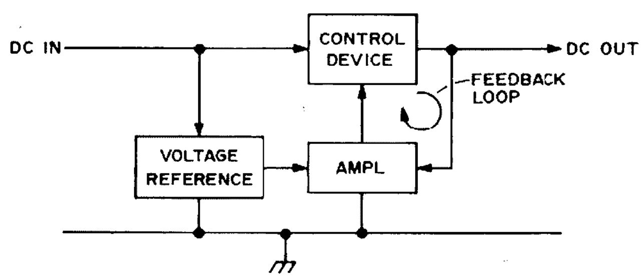


Fig. 11. This block diagram identifies the major functions within a typical electronically regulated power supply's regulator circuit. Input to this circuit is obtained from a conventional power supply. Output is controlled by a series control device, which is in turn controlled by an amplifier stage driven by the difference between the output voltage and an internal reference voltage. The result is that output voltage remains constant over a wide operating range.

tors, etc., which are required in practical regulators).

In this circuit, the voltage reference is a VR tube. Its regulation is much better when used as a reference, however, than when used directly as a regulator, because the load current on the reference remains constant. When near-perfect performance is required, special voltage-reference tubes guaranteed to maintain voltage within a fraction of a percent of rated levels are available.

The amplifier is a bit unusual in its hookup, because it must do the job of comparing output voltage with the voltage reference. In Fig. 12, it does so because the

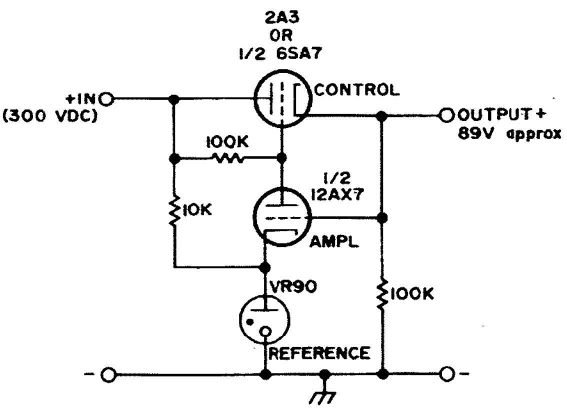


Fig. 12. Simplified schematic of regulator shown in Fig. 11. This circuit omits such items as parasitic suppressors, bypass capacitors, etc., to emphasize those parts which do the job of regulation.

output voltage is connected to the amplifier's grid and the reference voltage is connected to the cathode. This "clamps" the cathode permanently to the reference level.

So long as the output voltage is higher than the reference voltage, the grid of the amplifier is positive with respect to the cathode and the amplifier tube conducts heavy current. This causes a large voltage drop across the amplifer plate load resistor, and as we shall see shortly this in turn reduces the output voltage.

When the output voltage drops below the reference voltage, the difference between output and reference becomes the grid bias voltage for the amplifier, and plate current becomes less heavy. Output voltage rises. As output rises, the amplifier's bias decreases, which makes the amplifier draw more current and pulls down the output voltage. The output level thus stabilizes at whatever point produces an amplifier bias level capable of producing exactly the same output level. This is negative feedback in action, or what engineers call a "servomechanism."

The control device is an ordinary power tube or transistor. Fig. 12 shows a triode tube; tetrodes or pentodes require some special complications to keep the screen voltage at the right level. You can view the control tube as being a cathode follower, in which the cathode voltage "follows" the voltage applied to the grid, or you can look at it as being a variable resistance which forms the upper leg of a voltage divider, with the lower leg being composed of the load connected to the power supply.

The plate of the amplifier is connected directly to the grid of the control tube, so that whatever voltage appears at the amplifier is reproduced (except for a small offset voltage established by the tube's operating grid bias requirements) at the control-tube cathode, which is the output terminal of the circuit.

Now let's imagine that we have such a circuit, with all tubes warmed up and the VR tube glowing at a fixed voltage of +90V, but no power supplied to the amplifier and control-tube plates.

When we first apply power to the plates, the output voltage of the suply is zero, so the amplifier grid is effectively grounded. With the +90V from the reference applied to its cathode, the amplifier tube is effectively cut off and no current flows in its plate circuit. The voltage drop through the load resistor is thus zero, and full plate voltage is applied to the amplifier plate and the control-tube grid.

This full plate voltage is reproduced at the output terminal – but in order to rise from zero, where it started, to the full-voltage level, the output terminal must pass through every intermediate voltage level on its way, and as it does so this changes conditions inside the regular circuit in such a manner that the output voltage never climbs higher than the desired regulation point.

Until output voltage approaches the VR-tube voltage, nothing much happens. As soon as the difference between output voltage and reference voltage is smaller than the cutoff voltage for the amplifier tube, though, current begins to flow through the amplifier tube, and this current flow through the amplifier load resistor reduces the voltage at the amplifier plate and control-tube grid. Remember that the output voltage of the regulator can never be higher than the voltage at the control-tube grid.

As output voltage continues to rise, the difference between output and reference voltages continues to decrease, reducing the grid bias on the amplifier and thus increasing current flow through the amplifier load resistor. This increased current flow reduces the voltage at the amplifier plate and control-tube grid, and so reduces the upper limit to which output voltage can rise.

This action continues until the control-tube grid voltage and thus the output voltage is reduced to the point at which difference betweeen output and reference voltages is exactly right to maintain current flow through the amplifier at a level which will hold the control-tube grid voltage at that same point. Any additional rise in output voltage would then cause a fall in control-tube grid voltage, pulling output voltage back down, and so the action freezes.

The output voltage at which this "freeze" occurs depends upon the characteristics of the specific tubes used in the circuit, but is always a few volts lower than the reference voltage.

When a load is connected to the power supply output, the load current must flow through the resistance established by the control tube, and this increased current flow will cause output voltage to fall slightly. However, as soon as output voltage begins to fall, the difference between output and reference voltages increases, which means the the amplifier's grid bias increases and less current flows through its load resistor. This raises the voltage applied to the control-tube grid, which increases output voltage until the original level is

restored. Action occurs so rapidly that the change in output level is usually not detectable – but the change *must* occur in order for the circuit to detect and correct it.

If the power supply load requires additional current, the same thing happens – whenever current drain from the output terminals tends to pull output voltage down, the control tube's grid voltage is automatically increased just enough to bring it back up again. If the current taken from the supply is reduced, the action works in reverse. Any tendency of output voltage to rise above the established "regulated level" causes the control-tube grid voltage to be reduced, pulling output level back down. The action is effective over a wide range of current. Only when the original supply is unable to deliver enough current, or the control tube is unable to pass it, can the output voltage fall.

A regulator circuit such as this normally acts to reduce ripple in the output, as well as to clamp voltage level constant regardless of variations in load current, because any ripple which gets through is also detected as a variation in output voltage, and is canceled just as is any other output-level change.

A regulator circuit of this type acts to improve both the static and the dynamic regulation of the supply, and reduces output impedance of the supply to nearly zero.

A number of changes are possible to the basic circuit, which permit a circuit designer to choose any type of action he may desire. For instance, he may retain good static regulation and low dc output impedance, while deliberately introducing poor dynamic regulation and high ac output impedance, by placing low-pass filters in the amplifier circuit so that rapid changes in output level cannot cause changes in control-tube voltages, and so cannot be canceled. The simplest such low-pass filters are bypass capacitors from grid to cathode on both amplifier and control-tube stages. However, some bypassing is necessary to prevent oscillation, and so it's not safe to assume that the presence of capacitors at these points means that the designer has

chosen to degrade dynamic regulation.

Another modification which can be made permits the output impedance of the power spply to be made exactly zero, or even to be made negative. When output impedance is zero, a change in load current makes no change at all in output voltage. When output impedance is negative, output voltage actually climbs as current is drawn, and drops as current demand increases.

To achieve these effects, the designer need only include a low-value current-sensing resistor in the negative lead of the circuit, as shown in Fig. 13, and return the negative end of the reference voltage source to the *load* side of this resistor while returning the voltage-sampling network to the *regulator* side.

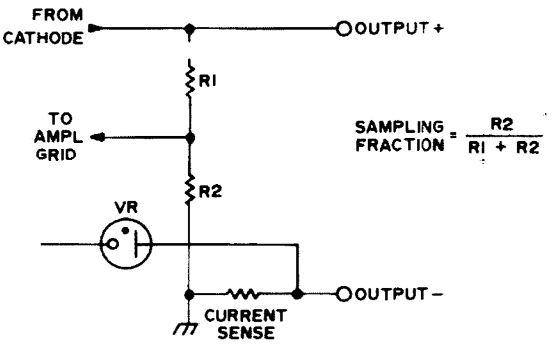


Fig. 13. Modifications to regulated power supply include voltage sensing network which permits output level to be higher than reference voltage, and series current-sensing resistor which allows output impedance to be reduced to (or even below) zero ohms.

As load current increases, the voltage across this current-sensing resistor also increases, and this change is added to the reference voltage "seen" by the amplifier. In effect, the reference voltage to which the output level is clamped is made to increase as load current increases, and the automatic clamping does the rest.

The size of the current-sensing resistor determines whether output impedance is zero or negative. The smaller the resistor's value, the less its effect. With a very low value, the effect can be made just enough to cancel the positive output impedance of the rest of the circuit, giving a net output impedance of zero. With higher values, output impedance becomes negative.

Figure 13 also introduced the "voltage-sampling network," which is simply a voltage divider connected across the output of the supply, with the amplifier grid or base connected to its midpoint. This network permits output voltage of the supply to be higher than the reference voltage, because it establishes the voltage fed to the amplifier as a fixed fraction of actual output voltage, and the regulator circuit actually clamps the voltage fed to the amplifier at the reference level.

For example, with a 90V reference source and a sampling fraction of 2/3, the regulator would hold output voltage at something less than 135V. If the bias requirements of amplifier and control stages introduced a 10V offset, so that the circuit would clamp amplifier-input-voltage level to 80V, then output would be 120V (2/3 of 120 being 80).

To change the output voltage of this supply to 200V, all that would be necessary (if unregulated input voltage were 300V or above as noted below) would be to change the ratio of the resistors in the sampling network so that the sampling fraction changes from 2/3 to 2/5. Now, when output is at 200V, 2/5 of this output, or 80V, is applied to the amplifier, and action is just the same as before.

In practice, most regulated supplies use such sampling networks, and include a potentiometer at the junction point to

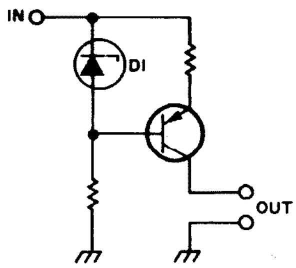


Fig. 14. Current regulator circuit uses two resistors, one zener diode, and a single transistor to regulate current to some maximum value set by design, over entire range from short-circuit to open-circuit load conditions. Naturally, design current cannot be made to flow through open circuit, but regulator assures that regulating level is never exceeded, and is achieved if input voltage is high enough to force that much current through load resistance.

permit variations of the actual output level by permitting small changes in sampling fraction. Some supplies have a wide adjustment range, while others permit only a narrow margin.

Note that a regulated supply of this sort requires an unregulated input voltage considerably higher than the desired output voltage. This additional voltage is necessary in order to provide operating voltage for the control device, and represents "wasted" power so far as the external load circuit is concerned. Current capability of the regulated supply is also limited by the control device. These two disadvantages are the major reasons why regulated power supplies are not more widely used. In ham gear, fully regulated supplies are found only in critical frequency-control circuits and low-current bias supplies, if at all.

While the term "regulated power supply" usually means a supply in which the output *voltage* is regulated, it's also possible to regulate output *current* so that it remains constant regardless of changes in load resistance. This is sometimes called "current limiting," as we did in discussing Fig. 10.

The need for current regulation occurs far less frequently than that for voltage regulation, however, and so in general use "regulation" has come to mean only "voltage regulation" unless specifically called out as applying to current.

Current regulation, when it is encountered at all, usually shows up the in voltage-reference portion of a regulated power supply, where the VR tube is supplied with constant current in order to hold its voltage more constant.

The simplest current regulator consists of a resistor, having a value from 10 to 100 times greater than the resistance of the expected load circuit, in series with a power supply which produces from 10 to 100 times the anticipated voltage requirement. Most of the voltage drops across the resistor, and current remains fairly constant.

For instance, a 300V supply connected through a 300 kΩ resistor will permit a maximum of 1 mA to flow, even if the output is shorted. With a load resistance of 30 kΩ the total series resistance is only 10% (9%, to be exact) less. If load resistance is not permitted to exceed 3 kΩ the resistance variation will be only 1%, and the current varies less than 1%. Voltage across the load rangs from 300 with no current flow down to zero with a short circuit.

For more effective regulation of current, a servo regulator such as that shown in Fig. 14 can be used. This circuit acts in much the same manner as the voltage regulator of Fig. 12, but combines the amplifier and control stages in a single transistor.

The transistor base is clamped to a voltage somewhat lower than the input voltage, by zener diode D1. Emitter voltage, however, varies with current flow through the circuit. With no current flow, the emitter resistor causes no voltage drop, the emitter is at input voltage, and since the transistor is PNP, this turns it on.

Emitter-to-collector resistance is low and high current can flow, just as output voltage could skyrocket (initially) in Fig. 12.

As current flows, however, it produces a voltage drop across the emitter resistor, reducing the difference between emitter and base voltages, and so reducing the forward bias on the transistor. Emitter-to-collector resistance increases.

When enough current is flowing to bring the emitter voltage almost down to the base level (because of the voltage drop in the emitter resistor), the high emitter-to-collector resistance at this operating point prevents additional current flow. Thus, even with the collector shorted to ground, only enough current can flow through the emitter resistor to bring emitter voltage down to base level and turn the transistor off.

For any value of load resistance from zero to infinite (short circuit to open circuit), current flow through the collector is held at the value which develops approximately the zener-diode voltage across the emitter resistor. With a 3.9V zener and 3.9 kΩ in the emitter, current regulated at 1 mA; with 390Ω at 10 mA, and so forth.

Many variations of regulator design and action are possible. It's far beyond the scope of this series to go into any greater detail now, but if your interest in the subject has been whetted you can find much additional data in either of these two books:

"Silicon Zener Diode and Rectifier Handbook," Motorola Semiconductor Products Inc., Phoenix, Ariz. ($2 when published in 1961).

"Electronic Designers' Handbook," edited by R. W. Landee, D. C. Davis, and A. P. Albrecht, McGraw Hill Book Company, Inc., New York, 1957.

Now that we know all about power supplies, or at least more than most of us really wanted to discover, we're ready to take a look at the subject of amplification.

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getting started in Radio

by FRED J. MOCKING

Once upon a time there was a young boy who lived in a big city. He attended school during the day (he was in the sixth grade), but at home in the evenings he "fooled around" with his electrical experiments. Tom's teachers said he was lazy and inattentive. He did not study his textbooks like the other kids did. He had a poor memory and was unable to remember things the teacher had told him the day before.

He was so lazy that he never wrote out the details of his arithmetic problems. He had decided that it was much easier to memorize all the tables up to 20 x 20, than to calculate them every time.

He spent considerable time at the library, looking for books on electricity and radio. He was "friends" with the radio serviceman in his neighborhood and with a neighbor who worked for the telephone company. He also had a very special friend who was a ham radio operator.

His basement workshop was a mess, with parts of old radios, discarded appliances, tubes, meters and assorted miscellany all over. By the time he was in eighth grade, he had built several 1 and 2 tube receivers and his latest project which he was just finishing was a six-tube superheterodyne. He also had built a ham band transmitter and had been on the air for about six months.

He had acquired a number of basic skills using electrical and electronic instruments, troubleshooting all kinds of equipment and doing some simple design work, based mostly on Ohms law.

During high school he continued his ham activities, and did just average in his school work. His math teacher told him he would never learn math and should avoid technical subjects. His physics teacher, however, was impressed by Tom and encouraged him, provided opportunities for him to use school equipment.

As you might expect, Tom decided to study electrical engineering in college. Here again, his grades were average, and studies left little time for ham radio. But Tom picked up some spending money working part time in a radio repair shop and, in his last year, worked as a technical assistant to one of the professors in the EE department.

The professor was working on a project that involved using tube circuits to perform mathematical computations. There were no textbooks to refer to. Every aspect of the equipment was a step into an uncharted land. How do you represent numbers using electrical circuits? What circuits do you need to perform arithmetic operations? How do you get results out of the machine?

The professor didn't want to hire Tom at first, but some of the A students working on the project were completely lost when it came to troubleshooting. And, in designing circuits that weren't in the textbooks, they were rather confused. So Tom got the job. And strange as it seems, this indifferent scholar, with "no talent" and a "bad memory," became a leader and an outstanding engineer on a project that opened up a whole new vista in technology – the computer era.

Why do we spend time to review this thumbnail sketch about Tom? Because what happened here is happening to thousands of Toms across the country. There's a chasm between the world of school and the world outside of school, and considerable misunderstanding about what constitutes learning.

Tom didn't trust words, or textbooks, but he felt intuitively that his experiments were worthwhile. Some educators say "You learn by doing," which is somewhat of an oversimplification. Tom's teachers didn't trust the real world; they only felt comfortable with the world of words, which is to a large extent an unreal world. And what does this all have to do with a magazine ?

If you want to learn electronics, you are going to learn about a lot of physical phenomena which exist without words, and which can be experienced and observed without words. This means that the equipment does the teaching.

If you want to argue, you can say "Wait! A magazine is nothing but words, so what gives?"

So here is the straight scoop:

The words can tell you what equipment to get and what to do with it. You have to *experience* how it works and that's *your* job. But afterwards, if you want to know *more*, people who have also experienced similar experiments and have written about them can communicate with you in the articles in this magazine.

This column will have comments on things to build, some techniques that help us understand the things we see, and some comments about learning, education, and communication.

Now, let's do some experimenting. I will assume that you own or can borrow a general purpose multimeter, also called a VOM (volt-ohm-milliammeter). If you have a VTVM (vacuum-tube voltmeter) you can use it as well for these experiments. You will also need some diodes and a few transistors.

There are many kinds of diodes that can be used. Rectifier diodes are usually readily available, and are often more clearly labeled than some others. Be sure the polarity is clearly shown. Transistors can be obtained as surplus or on surplus circuit cards. You should accumulate an assortment for experimenting. New transistors are fine but are usually somewhat more expensive.

Set the meter switch to the lowest OHMS scale, touch the prods together and "zero" the meter. Touch the test prods to the diode and read the meter. Now, turn

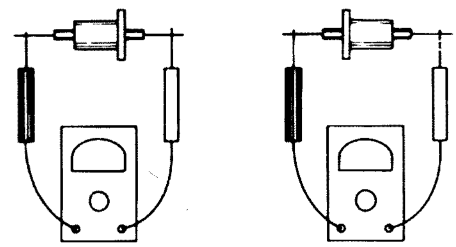


Fig. 1. Checking diode resistance in both directions.

the diode around and read the meter again. (see Fig. 1). One reading will be very low, as meter current flows through the diode in the "forward" direction. The other reading will indicate a high resistance (or open circuit) as the meter tries to "push" current through the diode in the reverse or blocking direction.

I have not given any numerical values of resistance because they would depend on many things, including the voltage of the dry cell in the meter, the diode being checked, and some other things. However, a good diode will read low in the forward direction and high resistance in the reverse direction.

Now, once more touch the meter prods to the diode with the diode in the forward or low resistance direction. Assuming that the diode is correctly marked, as shown,

and the prods are two different colors, usually red and black, two possibilities can arise, either A or B (Fig. 2). In A, "current" flows from the red prod, through the diode to the black prod. Knowing this, you can use the prod colors to help decide which way is forward for an unmarked diode. However, if B is the situation with *your* meter, then inter-

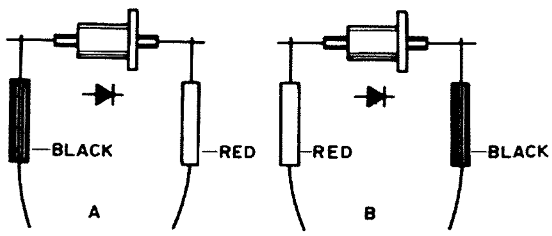


Fig. 2. The two possible arrangements that could give a "forward" reading, depending on the internal arrangement of your ohmmeter.

change the red and black leads *at the meter.* Now, to put current through the diode in the forward direction, your prods will match A, and you can still say that current flows from the red prod through the diode to the black prod.

When you are checking diodes or transistors, you can use the "reversed leads" trick described above. However, for voltage and current measurements, restore the leads to the proper positions. Incidentally, it is a good idea to label your ohmmeter

POLARITY REVERSED ON OHMS, or. . .
POLARITY CORRECT ON OHMS

whichever applies to *your* meter. This can save you from trouble and goof-ups later on.

You have now acquired a "test set" (and some knowhow) that will permit you to do the following:

1. Determine the forward and reverse direction of an unmarked diode,
2. Check diodes for "opens" (high resistance both ways).
3. Check diodes for "shorts" (low resistance both ways).

In addition, this know-how can be directly applied to checking transistors, by testing between two terminals at a time and interpreting the readings as though

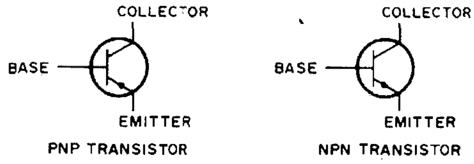


Fig. 3. Transistor symbols.

they were diode readings. Look at the transistor symbols in Fig. 3. The base and emitter form a diode, which can be checked just as we did before, with the ohmmeter. In the PNP transistor, "forward" is from emitter to base, while in the NPN transistor, forward is from base to emitter. These diodes can be normal, open, or shorted just as in any "regular" diode.

In a similar manner, the base–collector pair forms a diode, with polarity, for these tests, the same as the base–emitter diode. The "forward" polarities are:

PNP	NPN
Emitter-to-base	Base-to-emitter
Collector-to-base	Base-to-collector

In order to use this information, we need a guide that tells us which terminal is which on the physical transistor, since the leads are not marked. (See Fig. 4.)

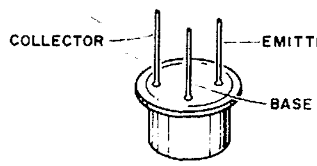


Fig. 4. Transistor lead identification.

You are now ready to take the ohmmeter and some transistors and check them to see if they are PNP or NPN. Then check for shorts and opens. Notice that there is no need to know how transistors "work" or how to design circuits, in order to perform these tests. Yet you will find yourself using this technique many times in the future. Even when you have much more elaborate test facilities you may want to run a quick check on a transistor or diode this way. So go to it, have fun, and the transistors, through the ohmmeter, will be happy to tell you about themselves.

. . .Mocking ■

Tell our Advertisers You Saw it in 73

REDUCING MOBILE NOISE

Ward Stewart VE3FGS
8 Church St.
Penetang, Ontario

With the introduction of transistorized 2m FM transceivers and various amateur receivers for mobile use, there is a natural tendency to pick up the supply voltage from the ignition switch or the switched terminals on the fuse panel. Reduced current demands have rather obsoleted the old power relay . . . but not quite.

Because of the compactness of wiring harnesses, all kinds of voltages are induced into other wires in the same harness. It is quite possible for your receiver to get alternator, gage, and turn-signal noises induced on the supply line, and much of it will get past the receiver's filtering and appear at the speaker terminals.

The best way to eliminate this problem is to run the supply lead directly from the battery terminal, and route it away from other wiring while keeping it close to the metal chassis parts of the vehicle, which of course are at ground potential.

The battery itself is a big fat capacitor and a beautiful hash filter! But taking our A lead directly from it means we have to turn the rig on by hand for now it won't come on automatically with the turn of the ignition switch.

Here we come back to our old friend, the relay. Any relay with the current capacity for your rig and a 12V dc coil is okay. Your local two-way radio serviceman will undoubtedly have some old ones he would be glad to sell cheap (or he may even give them away). If you want a new one, ask for Motorola part number 59K813674. It looks like a horn relay off a car but it isn't! The illustration shows both the physical and electrical layout of this particular relay.

Use of this type of voltage supply will do much to reduce "local QRN" generated by the vehicle. Give it a try. . . .VE3FGS■

PETITION filed by Wayne Green W2NSD/1, Peterborough, New Hampshire.

The Federal Communications Commission has had considerable difficulty with the 27 MHz citizens band. Thousands of operators are using this band for hobby purposes even though this is prohibited by the regulations. Thousands more are using illegal antennas and illegal power amplifiers. Thousands are using the band even without a legal license. It seems obvious that there is a demonstrated need for a hobby band if the appropriate frequencies can be allocated. Such a band would provide a legal way for these operators to communicate and could therefore free the 27 band for its original purpose as a semibusiness band.

The drop in the growth of the amateur radio service is reflecting along to the electronics and communications industries as a drop in the number of new workers entering this field. The needs of these industries are going to be greater than ever as computers and space-age communications gradually involve more and more businesses and sectors of the economy. A drop in men coming into these fields can seriously hurt the future of these industries. In all, it would seem prudent to do everything reasonable to try and encourage the growth of amateur radio at this time.

The major factors influencing the growth of amateur radio would seem to be the discouragement resulting from the introduction of the "incentive licensing" proposals by the ARRL, the institution of $4 license fee by the FCC, and the indescribable mess on the citizens band with 800,000 or so active stations using 23 channels, a situation which has tended to discourage the most likely amateur radio prospects and divert them to other interests.

The FCC in Docket 18802 has indicated that it is interested in making revenue meet expenses and has proposed that amateur license fees be raised to $9 and the citizens band fees raised to $19. The result of this would seem to be even more problems for both services, with the recent very slight upturn in the issuance of amateur licenses possibly turned down again and the impressive increase in completely unlicensed citizens band operation becoming the rule rather than the exception. The Commission is asked herewith to consider an alternative source for the needed income that might be derived from the increase of these two fees, thus eliminating at least the need for the increase in the amateur radio fees.

The Commission has been requested to establish a hobby-type license in the past with allocations in the amateur ten-, six-, and two-meter bands. Each of these requests has had serious drawbacks which have prevented their implementation. Basically, though none of these amateur bands are fully used, all of them are extensively in use and the opening of a substantial range of frequencies for a new amateur license would inevitably cause a hardship to those now using the band and to those amateurs who might want to use the band in the near future. There is one amateur band, however, that has been almost completely passed by and which shows no signs of serious amateur development in the foreseeable future. This is the amateur 220–225 MHz band. It would seem important that this wide and valuable amateur band should be developed if it is to be retained at future international conferences. There are many practical reasons why this band has been skipped in the expansion of amateur radio into the microwaves: The next band up is better for moonbounce work, more commercial equipment is available for the 450 MHz band, repeater controls are on this band, dish antennas become practical at the higher frequency, and television is allocated on 450 MHz.

The Solution. . .

It is hereby proposed that the Commission institute a Hobby class amateur license which will have no code and no theory elements, only a rules and regulations examination which can be administered by any licensed amateur, General class or above, and which will permit the holder to operate with a power of up to 100 watts using narrowband FM (15 kHz deviation) in the frequency range from 220.5 to 224.5 MHz. This license would be available for a fee of $5 for a five-year period and would be renewable upon proof of use and a $5 fee. The 220.-220.5 and 224.5-225.0 MHz segments of the band would still be open to higher classes of license as presently authorized, thus preserving one MHz of the band for exclusive use of the higher classes of license.

This Hobby class license would provide the band that the citizens band operators need, one where hobby operation is legal, and would thus free the 27 MHz band for business and personal business use as originally proposed by the Commission. The large number of channels available in the 220 MHz band would provide relatively interference free communications for the operators, offering them adequate reasons for changing from the 22 channels on 27 MHz. The coming dropoff in skip conditions on 27 MHz will work to the end of encouraging the changeover. This band, as with all other amateur bands, would be largely self-policing, thus removing a very expensive headache from the Commission.

It is suggested that the Hobby class license permit communication through repeaters, but that a higher class license be required for the installation and maintenance of a repeater, since technical knowledge is much more necessary for the installation than the use of a repeater.

It might be pointed out that the amateur 220 MHz band is above television channel 13 and that interference to television reception would thus be unlikely. Second harmonic radiation would be within the 450 MHz amateur band and would also be unlikely to interfere with commercial bands. The 500 kHz guard bands on each side of the proposed Hobby band would provide adequate isolation for errant operators to keep them from interfering with adjacent commercial bands.

The use of FM techniques would reduce the problems of heterodynes which contribute so much to the frustrations of the 27 MHz band and would provide simple network systems with squelch as is now popular on the 144 MHz band. Though crystal control would not be required, it would probably be extensively used as it is for 144 MHz FM operations.

In order to indicate the class of license by the call letters it is proposed that a new set of callsigns be established for the Hobby class license using the regular amateur call areas, but starting with NA1AAA and going through to NZ1ZZZ, a system which would provide for over 4,500,000 callsigns to be issued. When a Hobby Class operator goes to a higher class of license the last three letters could be passed along to the WA1AAA type of call letter, thus preserving the identity of the operator through this counterpart call.

Summary

The Hobby Class license would seem to fulfill a number of needs without taking anything away from anyone. It would provide a large hobby band which is obviously needed. It would help the Commission solve the problems of the citizens band. It would provide activity on a virtually unused amateur band. It would encourage an influx of new amateurs. It would provide millions of dollars in fees to offset Commission expenses, with little overhead involved since all of the examinations would be given by volunteer radio amateurs. It would encourage the development of commercial narrowband FM equipment for the VHF bands which would benefit all amateurs as well as the users of adjacent commercial bands. It would encourage the development of fixed station equipment, mobile equipment, portable equipment and handie-talkie equipment, autotuning receivers, autocall signaling equipment, etc. It would also give a number of manufacturers a very bright future.

Thus the Commission gains, the amateurs gain, the country gains, the manufacturers gain, and no one loses.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)
	)
Amendment of Part 95 and Part 15 of the Commission's Rules Concerning the Allocation and Assignment of Frequencies for Unlicensed Communication, Class D Citizens Radio Service and a New Proposed Class E Citizens Radio Service	)

PETITION OF PROPOSED RULEMAKING

There has been demonstrated a strong current and growing need for personal two-way radio communications for both safety and convenience of individual citizens in conducting their daily activity of both a personal and business nature. This need initially was served by the establishment of Class D Citizens Radio Service in 1958, providing twenty-three crystal controlled channels with 10 KC spacing in the 27 MHz band. In the establishment of the Class D Citizens Radio Service, the Commission correctly recognized the need and right of individual citizens to have use of a portion of the R. F. Spectrum to conduct their affairs for convenience and safety via personal two-way radio. The technical limitation of 27 MHz and the limited number of channels made available have prevented the Class D Citizens Radio Service from meeting its total objective. We have learned much concerning the public's needs for personal two-way radio communications, even with these limiting factors. We can now more completely define and more adequately serve this requirement for personal two-way radio service.

I. CITIZENS NEED FOR PERSONAL TWO-WAY RADIO

In our mobile society today, we have an ever-increasing need for personal two-way radio communication from moving vehicles and in remote areas where land line communications facilities are not available. The primary need is for short range communications (within ten miles). The cost of equipment must be kept low for the greatest benefit to the greatest number of citizens. The service must offer the greatest flexibility of use so that the citizen may avail himself to this service in all his activities, whether he be in his home or automobile or on a fishing or camping excursion.

The Class D Citizens Radio Service, with 000,000 active licensed operators, has shown that low cost equipment owned and operated by the user provides the most satisfactory service.

II. JUSTIFICATION FOR EXPANSION OF PERSONAL RADIO SERVICE

The benefits of personal ownership and operation of Citizens Two-Way Radio have been proved over and over again in the number of public assistance acts that have been performed on the Class D Citizens Radio Service throughout the country. The examples of assistance, both for safety and convenience, that have been rendered to the general public by Class D Citizens Radio operators is far greater per license than any other radio service except the Public Safety Agencies themselves. There are countless examples of cooperation with law enforcement agencies and other local agencies by the Class D Citizens Radio Operators in providing assistance in time of major and minor emergency that arise every day in communities throughout the country. The cost of providing this benefit to our population could not possibly be met by any practical means other than personal ownership and operation of Citizens Personal Two-Way Radio equipment.

III. REQUIREMENTS FOR IMPROVING PERSONAL TWO-WAY COMMUNICATIONS SERVICE.

A. Operating regulations must be simple to understand and easy to administer. Operating procedures must be established to provide a high degree of self-regulation so that a minimum of cost is required for enforcement.

B. Equipment must be low initial cost and require a minimum of service expense.

C. Flexibility of operation must be provided so the maximum utilization of frequency can be obtained. The service must provide a satisfactory number of channels for local operation so that open channel space can be selected freely by the operator. Operating guidelines must be established so that maximum utilization can be obtained with the least confusion and interference.

D. Proper location in the frequency spectrum must be made to minimize the technical operating problem, short range communications in all types of terrain and populated areas must be accomplished with minimum interference due to man-made or natural interference.

E. Licensing procedures must be simplified to permit efficient handling of the large numbers of licensing that are required for this personal radio service.

The original establishment of the Citizens Radio Service by the FCC and subsequent establishment of the Class D Citizens Radio Service was to "provide the broadest possible public use and benefit of the frequency spectrum of necessary business and personal communications". The following factors concerning allocation of frequencies in the Class D Radio Service.

1. Technical atmospheric (skip) conditions make the Class D Citizens (27 MHz) band more conducive to long distance amateur type operation than the short-range communications to which the operation is restricted.
2. R. F. noise, both man-made and atmospheric, coupled with low power and low antenna height restrictions, limit the range of Class D Citizens (27 MHz) band in metropolitan areas to the point of questionable operational effectivness for its intended purpose.
3. Overcrowded conditions on the 23 channels of the 27 MHz Class D Citizens Radio Service, together with the above factors, has degraded the Citizens Radio Service to a level of ineffectiveness in many areas.

A new "Class E Service" is proposed as the best possible solution to provide the U.S. Citizens with properly regulated frequency spectrum for "personal communications".

A new Class E Citizens Radio Service is requested to be established between 222 and 224 MHz. The current Amateur Radio Service Frequency allocation of 220 to 225 should be changed to 220 to 222 MHz for one class plus 224 to 226 MHz for another class.

This new Class E Citizens Radio Service should then be established by specified channels covering the 222 to 224 MHz range. As a guideline in establishing technical and operating parameters, it is recommended that the VHF Marine regulation be referred to as an excellent example of providing the greatest use to the general public of the limited frequency spectrum available to satisfy the growing need for more short range "personal communications."

The following regulations for operation are recommended with the basic objective of providing communications for the mobile public for convenience and safety up to a reliable range of ten to twenty miles.

A. Power output to antenna limit of twenty-five watts with special "public service" license on base station allowed at one-hundred watts output to antenna.

B. Antenna height limit of twenty feet above the nearest man-made or natural object within 500 yards; or sixty feet above the existing terrain (whichever is higher).

C. Frequency assignments are requested as follows:

Transmission of FM voice only with 25 KC spacing. Crystal controlled transmission only. 80 channels assigned as follows:

Channel		Frequency
1	mobile to same license	222.000
2	mobile to same license	222.025
3	mobile to same license	222.050
4	mobile to same license	222.075
5	mobile to same license	222.100
6	mobile to same license	222.125
7	mobile to same license	222.150
8	mobile to same license	222.175
9	emergency use only per Class D Channel 9	222.200
10	mobile to same license	222.225
11	mobile general calling for contact only; must change to alternate channel for message	222.250
12	travel assistance use only mobile general calling permitted	222.275
13	travel assistance use only mobile general calling permitted	222.300
14	weather advisory use general calling permitted	222.326
15	traffic advisory use general calling permitted	222.350
16	mobile to unit of same or different license	222.375
17	mobile to unit of same or different license	222.400
18	mobile to unit of same or different license	222.425
19	mobile to unit of same or different license	222.450
20	mobile to unit of same or different license	222.475
21	mobile general calling for contact only; must change to alternate channel for message	222.500
22	mobile to unit of same or different license	222.525
23	mobile to unit of same or different license	222.550
24	mobile to unit of same or different license	222.575
25	mobile to unit of same or different license	222.600
26	mobile to unit of	222.625
27	mobile to unit of same or different license	222.650
28	mobile to unit of same or different license	222.675
29	mobile to unit of same or different license	222.700
30	mobile to unit of same or different license	222.725
31	mobile to unit of same or different license	222.750
32	mobile to unit of same or different license	222.775
33	mobile to unit of same or different license	222.800
34	mobile to unit of same or different license	222.825
36	mobile to unit of	222.850
36	road condition information only; power limit of 1 watt TX audio call signs	222.075
37	road condition information only; power limit of 1 watt TX audio call signs	222.900
38	road condition information only; power limit of 1 watt TX audio call signs	222.925
39	road condition information only; power limit of 1 watt TX audio call signs	222.950
40	road condition information only; power limit of 1 watt TX audio call signs	222.975
41	local traffic control use only; for a limit of 1 watt	223.000
42	local traffic control use only; for a limit of 1 watt	223.025
43	local traffic control use only; for a limit of 1 watt	223.050
44	local traffic control use only; for a limit of 1 watt	223.075
45	local traffic control use only; for a limit of 1 watt	223.100
45	In plant use only; limit of 1 watt	223.125
47	in plant use omy; limit of 1 watt	223.150
48	In plant use only; limit of 1 watt	223.175
49	In plant use only; limit of 1 watt	223.200
50	In plant use only; limit of 1 watt	223.225
51	local use of units with same call sign; limit of 1 watt	223.250
52	local use of units with same call sign; limit of 1 watt	223.275
53	local use of units with same call sign; limit of 1 watt	223.300
54	local use of units with same call sign; limit of 1 watt	223.325
55	local use of units with same call sign; limit of 1 watt	223.360
56	marine use only limit of 1 watt	223.376
57	marine use only: limit of 1 watt	223.400
58	marine use only; limit of 1 watt	223.425
59	marine use only	223.450
60	marine use only	223.475
61	limited to units of same license; limited to contact only; to contact only; units must change to alternate channel for message	223.500
62	limited to units of same license; forbusiness communications only	223.525
63	limited to units of same license; for business communications only	223.550
64	limited to units of same license; for business communications only	223.575
65	limited to units of same license; for business communications only	223.600
66	limited to units of same license; for business communications only	223.625
67	limited to units of same license; for business communications only	223.650
x68	limited to units of same license; for business communications only	223.675
69	limited to units of same license; for business communications only	223.700
70	limited to units of same license; for business communications only	223.725
71	for units of the same or different license; limited to contact only; units must change to alternate channal for massage	223.750
72	for units of the same or different license	223.775
73	for units of the same or different license	223.800
74	for units of the same or different license	223.825
75	for units of the same or different license	223.850
76	for units of the same or different license	223.875
77	for units of the same or different license	223.900
78	for units of the same or different license	223.925
79	for units of the same or different license	223.950
80	for units of the same or different license	223.975

It is recommended that all transceiver equipment be required to have a switch cutting power to one watt transmit to the antenna. It is further recommended that repeater operations be permitted on channels 61 through 80 with the restriction that tone control be required on all repeater operations. Licensing on Class E Citizens Radio Service should be established so that each transmitter must have an individual license with a license fee of $3.00 for each transmitter, valid for five years. A provition should be made that license applicant may be granted the same license identification number he is using on other equipment within the service. An exception to this rule would be a license may be granted on a no-charge basis for any authorized Public Service Agency.

The manufacturer would be held responsible to include a short form Class E Citizens license application with the owner's manual of each set and the dealer held responsible for assuring that an application is passed on to the purchasers of the transceivers at the time of sale of new and used equipment to a user.

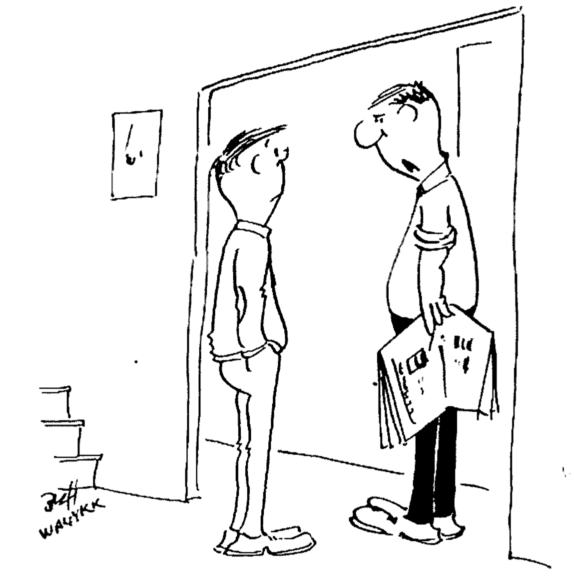
To simplify licensing procedure in the case of individuals, a short form license application (included with each set) may be used to self-assign call numbers which require no response from the Commission. A sample short form licensing procedure is attached.

Further control of illegal or improper equipment sale and operation is established by requiring the Manufacturer and Dealer to certify that the equipment, when sold, complies with the applicable regulation.

It is urged that the Commission move with haste to provide this much-needed rulemaking for the benefit of all citizens and their growing requirement for personal two-way radio communications for convenience and safety.

Very truly yours,

W. I. Thomas - Chairman
Citizens Radio Section
Industrial Electronics Division
Electronic Industries Association



"A 30 to 50 megacycle rig? Why can't you walk to school like I did?"

73 Reader Service Coupon

Now we don't say that every single reader must buy every last product advertised in 73. We believe that, but we don't say it. The very least every reader can do is to put on a show of interest in the products herein advertised. To make this a simple task, even for the laziest reader (now there is a contest for you!), we have cleverly arranged the advertising index to double as a readers service coupon. All you have to do is tear it out (or photocopy it) and send it in with the appropriate boxes marked. (We have a prize for the most boxes marked . . . a silent prayer of thanks from the publisher). We'll accept postcards, slips of paper, or almost anything else that lists the companies you want to hear from and your address.

No one likes to go into a store without buying something, right? It is the same with these information requests. You will be expected to buy something. Oh, it doesn't have to be a $50,000 antenna system, but it should be something modest . . . a transceiver . . . a linear . . . you know. We'll leave the decision up to you, knowing that we can trust you to do the right thing.

And we are definitely not saying that the use of this service coupon has any curative powers, but we cannot but notice that many readers report remarkable relief from simple backache, headaches, lumbago, and acid indigestion after sending in their coupon. Why take any chances?

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March 1971

SUN	MON	TUES	WED	THUR	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11	12	13
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EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7A	7	7	7	7	7	14	14	21	21
ARGENTINA	21	14	14	7	7	7	14A	21	21	21	21	21
AUSTRALIA	21	14	14	7B	7B	7B	7B	14	14	14	21	21
CANAL ZONE	21	14	7A	7	7	7	14	21	21A	21A	21	21
ENGLAND	7	7	7	7	7	7B	14	21	21	21	14	7B
HAWAII	21	14	7A	7	7	7	7	7B	14	21	21A	21
INDIA	7	7	7B	7B	7B	7B	14	14A	14	7B	7B	7B
JAPAN	14	14	7A	7B	7B	7	7	7	7B	7B	7B	14
MEXICO	21	14	14	7	7	7	7	14A	21	21	21	21
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PUERTO RICO	14	14	7	7	7	7	14	21	21	21	21	14
SOUTH AFRICA	14	7	7	7	7B	14	21	21A	21A	21	21	21
U. S. S. R.	7	7	7	7	7	7B	14	21	14	14	7B	7
WEST COAST	21	14	7A	7	7	7	7	14	21	21	21A	21

CENTRAL UNITED STATES TO:

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ARGENTINA	21	14	14	7	7	7	7A	14A	21	21	21	21
AUSTRALIA	21A	21	14	7B	7B	7B	7B	7B	14	14	21	21
CANAL ZONE	21	14	14	7A	7	7	7	14A	21A	21A	21	21
ENGLAND	7	7	7	7	7	7	7B	14	21	21	14	7B
HAWAII	21	21	14	7	7	7	7	7	14	21	21A	21
INDIA	7	14	14	7B	7B	7B	7B	7	14	7B	7B	7B
JAPAN	21	14	14	7B	7	7	7	7	7	7B	7B	14A
MEXICO	21	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	14	7B	7B	7B	7B	14B	7B7	7B	7B	14
PUERTO RICO	14	14	7A	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14	14	7	7	7B	7B	14	21	21A	21	21	21
U. S. S. R.	7B	7	7	7	7	7B	7B	14	14	14	7B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
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ARGENTINA	21	21	14	7B	7	7	7B	14	21	21	21	21
AUSTRALIA	21A	21	21	14	7A	7B	7B	7B	14	14	21	21
CANAL ZONE	21	14	14	7A	7	7	7	14	21	21A	21A	21
ENGLAND	7B	7	7	7	7	7	7B	7B	14	21	14	7B
HAWAII	21A	21	21	14	7	7	7	7	14	21	21A	21A
INDIA	7B	14A	14	7B	7B	7B	7B	7B	7	7	7B	7B
JAPAN	21	21	14	7B	7	7	7	7	7	7	7B	14A
MEXICO	21	14	7A	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	21	14	7B	7B	7B	7B	7	7	7	7B	14
PUERTO RICO	21	14	14	7	7	7	7	14	21	21A	21A	21
SOUTH AFRICA	14	14B	7	7B	7B	7B	7B	14	21	21	21	21
U. S. S. R.	7B	7	7	7	7	7B	7B	7B	14	7B	7B	7B
EAST COAST	21	14	7A	[illegible]	7	7	7	14	21	21	21A	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.


Amateur Radio
73
#127
One Lousy Dollar
Adult
GIANT FM REPEATER ISSUE
FM 1971
• Repeater Directory
• Transceiver Directory
• Buildit FM Walkie Talkie
• Much etc.

73 MAGAZINE

#127 April, 1971

FEATURES

STAFF

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Phone: 603-924-3873.

What staffers of what ham magazine have mysteriously emerged with conditional licenses? Do they even know the code? or a dB from a farad?

The Cover
Does FM run in the Sessions blood? Here is Murry Sessions, daughter of K6MVH/1 and WA6SPT/1, really enjoying the new Drake TR-22 2m FM transceiver, a six-channel portable unit which can operate from 115V ac, 12V dc or built-in batteries.

Don't miss the Dayton Hamvention – April 24th

Amateur Radio News Page

April MCMLXXI | Monthly Ham News of the World | Magazine

FCC TO ALLOW RTTY SPEED INCREASE

FCC Agrees to Up RTTY Speed

The Commission has under consideration two petitions for rule making submitted by Mr. Keith B. Petersen (W8SDZ) and Mr. R. Bruce Peters (WB2LRS). Mr. Petersen requests that the rules be amended to allow the use of radio teleprinter speeds of 60, 75, and 100 wpm and Mr. Peters proposes the use of 60, 67, and 100 wpm.

In support of their requests, the petitioners indicate that present commercial teleprinter standards include faster operating models as well as 60 wpm machines. In addition, it is indicated that the present maximum frequency shift of 900 Hz would not be exceeded in the use of the higher speed machines and compliance with present bandwidth limitations is possible. Further, it is pointed out that higher-speed operation will stimulate the development of new amateur skills and techniques, and will enhance the ability to handle large volumes of communications in less time. Such ability would be especially important during emergencies.

FCC is said to believe that provision for the use of additional teleprinter speeds in he amateur service, in keeping with commercial equipment standards now in use, is desirable. Since increased speeds are attainable within limits of the present bandwidth requirements, additional interference

EXTRA!

FCC Announces Proposed New Phone Bands!

Minutes before this issue went to press the FCC announced their proposal for an expansion of the lower phone bands. We will have full details next month. The deadline for filing comments on the docket is June 1, so the May issue will give you plenty of time to mull over the ramifications of the proposal.

As a starter it is proposed to cut back the four Extra class CW bands to 10 kHz apiece.

The new Extra class phone bands would start at 3.750, 7.150, 14.150, 21.200, and 28.350 MHz. The Ad- 7075–7100 kHz. The 40m Novice band would be moved to 7.100–7.150 to make room for the new phone band. The 15m Novice band would be shortened a bit to 21.100–21.200 MHz and a new Novice band would be added on 10m to make up the difference from 28.150 to 28.250 MHz.

That's quite a bunch of changes and they will doubtless be met with mixed emotions. Since it is unlikely that anyone else will bring it up, I suppose it is up to me to mention that

THE AMSAT REPEATER

More on the AMSAT Repeater

Work is proceeding on AMSAT-OSCAR-B (A-O-B), the first of a series of long lifetime amateur communications satellites designed for launch as secondary payloads on Thor-Delta or Agena missions. A detailed specifications document on this series of spacecraft was prepared in April and distributed as guidance material for persons indicating a serious interest in developing experiments for these satellites. There are now several experiments under development.

A four-channel, hard-limiting FM repeater is being breadboarded by members of WIA Project Australis who had been involved in the construction of AO-5. The repeater is of the demodulation-remodulation type and employs a frequency of approximately 145.9 MHz for the uplink and 432.1 MHz for the downlink, with a satellite transmitter power output of 1W per channel.

A linear repeater with a bandwidth of 50 kHz is under construction by the EURO-OSCAR group in Marbach, power loads. They are expected to make possible satellite operating lifetimes in excess of one year.

Following designs prepared by AMSAT's A-O-B project manager, Jan King, the A-O-B internal structural assembly and experiment modules have been fabricated at the facilities of W2QJT in Ithaca, N.Y. This is actual flight hardware, and represents the beginning of construction of the A-O-B spacecraft.

An AMSAT proposal to NASA for the launch of AMSAT-OSCAR-B was submitted in August and an oral presentation was given in November. A third-party agreement has been arranged between Australia and the U.S. to permit the exchange of third-party amateur traffic concerning the satellite. This arrangement extends the previous agreement, and is set up so as to last until several months after the end of life of OSCAR 6.

FCC

from such operation is not anticipated. In addition, since the teleprinter speed of 67 wpm is only a slight variation from the 60 wpm rate, the proposed use of 60, 75, and 100 wpm is considered to offer the most desirable variety of choices for operation

vanced class phone bands would start at 3.775, 7.175, 14.175, 21.225, and 28.375 MHz. The General phone bands would start at 3.875, 7.225, 14.250, 21.325, and 28.500. A new phone band for DX operating only, between Region II (ours) and the other regions is proposed for the proposals follow rather closely the suggestions I have made in my editorials.

I'll try and cover the whole situation next month in depth so, depending upon your convictions, stand by for massive reassurance or deep trauma.

HAM CUT-UP CITED BY FCC; RACISM CHARGED

The Commission, by the Chief, Safety and Special Radio Services Bureau, under delegated authority, having under consideration the suspension of the General class amateur operator license of Russell E. Jantzen, 12149 Indiana Avenue, Riverside, California, which is scheduled to expire August 8, 1973, has released an order calling for the suspension of his license.

According to FCC examiners, the licensee, while operating amateur radio station W6TBN, willfully and repeatedly transmitted communications containing obscene, profane, or indecent words, language, or meaning, in volation of Section 97.119 of the Commission's rules; and

The order also stated that the licensee used amateur radio station W6TBN for the purpose of transmitting unidentifiable noises and sound effects over extended periods of time; that such transmissions were not in plain language nor in the form of generally recognized abbreviations established by regulation or custom; that such transmissions were willfully and repeatedly made by licensee; and that such transmissions were in violation of Section 97.117 of the Commission's rules.

An interesting and perhaps precedent-setting observation was the notation that, on August 7 and 14 and September 28, 1970, licensee transmitted communications containing *language derogatory of certain races.*

According to the report, the licensee misrepresented material facts to, or concealed them from, the Commission, or was lacking in candor in his responses to official notices of violation.

It was ordered that the General class license of Russell E. Jantzen be suspended for the balance of the license term.

ASSISTANT FCC LEGAL CHIEF NAMED

The FCC announces the appointment of Vergil W. Tacy as Assistant Chief of the Legal, Advisory and Enforcement Division in the Safety and Special Radio Services Bureau. Mr. Tacy has served as a trial attorney in the Hearing Division of the Commission's Broadcast Bureau since he joined the FCC in 1961. Prior to his Government service with the FCC, he engaged in the private practice of law, and later served as a trial attorney and supervisory attorney in charge of litigation for the Securities and Exchange Commission. As special assistant to the U.S. attorney general, Mr. Tacy also engaged in the prosecution of criminal cases involving securities fruads. From 1942 to 1946, Mr. Tacy served in the Navy.

A native of the State of Iowa, Mr. Tacy received a B.A. degree from the State University of Iowa in 1935 and a Juris Doctor degree from the College of Law of that University in 1938. He is a member of the bars of the District of Columbia, Iowa, and Michigan.

Married to the former Frances Datesman, also from Iowa, Mr. Tacy and his wife reside in Chevy Chase, Maryland, and have three children.

Systemized ICs for Hams

Lithic Systems, Inc., makes its bow as the first manufacturer of communication ICs wholly committed to communication equipment. By applying LSI (large-scale integration) techniques to linear circuits, the company is developing lines of complex monolithic products to economically perform entire subsystem functions in two-way radios. Recognizing the need for direct interaction with manufacturers of airborne, mobile, handheld and other communication systems, Lithic Systems has developed a line that is a compatible group of monolithic subsystems featuring low power drain and low supply voltage capability.

The company presently uses a number of established subcontractors to perform routine production functions.

Robert A. Hirshfeld, founder and president, is formerly of National Semiconductor, where, as manager of communication circuits, he was responsible for the development and market establishment of their communication microcircuit line. An MIT graduate, he was an early participant in the development of linear integrated circuits at Motorola Semiconductor and then with Amelco Semiconductor, prior to joining National.

Facilities are established in Cupertino, California, with subcontractors in the San Francisco Bay Area and the Orient.

West Germany. This repeater has an input frequency of 432.1 MHz and an output frequency of 145.9 MHz, with a satellite transmitter power output of 10W. The repeater is designed for use with SSB, CW, AM, FM, RTTY or SSTV, with as many stations as can fit within its 50 kHz passband.

Also being breadboarded is a linear repeater under construction by AMSAT members in the U.S. This repeater has an input frequency of 145.9 MHz and an output near 29.6 MHz, with a satellite transmitter power output of 2W. This repeater will be capable of being used with any method of modulation permitted in these two bands.

The WIA Project Australis group has developed an OSCAR telemetry encoder which transmits telemetered satellite parameters directly in 850 Hz frequency-shift keyed Teletype format, for printout on an ordinary 60 wpm teleprinter. Any station having a tape reperforator will be able to send or retransmit the received data directly to AMSAT headquarters for computer processing, or they may decode the telemetry data themselves using calibration information which will be made available prior to launch.

John Goode (W5CAY) has designed and breadboarded an OSCAR telemetry encoder which transmits satellite telemetered parameters directly as numbers in code, so that only pencil, paper, and calibration information are needed for reception and interpretation of data from the satellite.

A breadboard of a command encoder capable of providing up to 35 separate command functions has been constructed by the WIA Project Australis group. The command encoder is designed to provide a reliable and secure means of controlling the emissions of OSCAR satellites to minimize any possibility of interference.

Several panels of solar cells left over from NASA and ESSA satellite programs have been made available for use in the A-O-B series of satellites. Several of these panels are being reconfigured for use in A-O-B. Rechargeable nickel-cadmium batteries have also been made available and have been undergoing charge-discharge cycle testing under simulated satellite

CHIEF RETIRES

Everett G. Henry, FCC Chief of the Amateur and Citizens Division of the Safety and Special Radio Services Bureau, is retiring February 16, 1971, after more than 32 years with the Commission.

Mr. Henry was named Chief of the Amateur and Citizens Division on January 7, 1966. He had previously been Chief of the Marine Division of the Safety and Special Radio Services Bureau for six years.

In 1938, Mr. Henry joined the FCC as a field radio inspector. He was employed in private industry from 1945 to 1948, when he returned to the Commission. From 1953 to 1956 he was Engineering Assistant to former Commission Edward M. Webster. In March, 1957 he was named Assistant Chief for Engineering in the Office of Opinions and Review.

Mr. Henry is a native of Corvallis, Oregon. He received a B.S. degree from the University of Washington in 1930. Before joining the FCC he served as radio operator on passenger and cargo vessels, as chief engineer of a number of broadcast stations, and as a development engineer in a telephone laboratory.

Henry, an active amateur, does not intend to give up his call (W3BG) or to drift out of ham radio. The photo here shows Mr. Henry speaking to a gathering of FM operators at the recent SAROC funfest in Las Vegas, Nevada.

ROCKAWAY

The Spring Auction of the Rockaway Amateur Radio Club will be held Friday evening, April 23, 1970, at the American Irish Hall, Beach Channel Dr. at Beach 81st Street, Rockaway Beach, N.Y. Doors open at 6 p.m. to accept items for the sale. A $1 donation accepted at the door; refreshments included. For further info write Al Smith, WA2TAQ, Box 341, Lynbrook NY 11563.

GEORGIA QSO PARTY

Starts: 2000 GMT, Sat. May 1, 1971
Ends: 0200 GMT, Mon. May 3, 1971

The tenth annual Georgia QSO Party is sponsored by the Columbus Amateur Radio Club, Inc. There are no time or power restrictions and contacts may be made once on phone and once on CW on each band with the same station.

Exchange: QSO number, RS/RST report, and QTH (county for Georgia stations; state, province, or country for others).

Scoring: Each complete contact counts 2 points. Georgia stations multiply their total QSO points by number of different states and Canadian provinces worked. DX stations may be worked for QSO points but do not count as multipliers. Out-of-state stations will use the number of Georgia counties worked for their multiplier (a possible total of 159).

Awards: Certificates to the highest scoring station in each state, province, country, and Georgia county and also to the highest scoring Georgia and non-Georgia Novice. Second- and third-place awards will be made in sections where additional recognition is deemed to be warranted. A plaque will be presented to the highest-scoring out-of-state entry, to the Georgia club with the largest aggregate score, and to the highest-scoring Georgia portable or mobile station operating within the state outside his

EE "HAMS" MEET AT CHICAGO

Shown are "ham" operators communicating with other radio amateurs during the recent National Electronics Conference attended by over 5000 electronic engineers and held in Chicago. The 2 kW SR-2000 base station was installed by Don De Jong (W9KUJ) (shown in foreground with mike in hand) and the radio equipment was provided by Hallicrafters. From left: Bud Drobish (W9QVA) Hallicrafters' Assistant Sales Manager; Cliff Mathews, Jr., Hallicrafters' Marketing Manager, and Rudy Napolitan, Conference's General Manager. Sitting next to Mr. De Jong representing the women "hams" is Ethel F. Marks (WA9ACO).

To promote amateur radio to the many electronic engineers in attendance at the recent National Electronics Conference in Chicago, amateur radio equipment provided by Hallicrafters, Rolling Meadows, Illinois was used. A 2 kW base station within the Conrad Hilton Hotel was installed by Don De Jong (W9KUJ), Chicago Area Radio Club Council Convention Chairman. The "hams" operated the Hallicrafters SR-2000 system consisting of the SR-2000 transceiver, the P-2000 ac power supply, the HA20 VFO DX'er unit and microphone.

WICHITA THEFT

The following equipment was stolen from the emergency communications truck belonging to the American Red Cross in Wichita, Kansas: Drake R-4B Receiver less power supply, serial #111250; Drake T-4XB transmitter less power supply, serial #16428R; Gonset "Communicator II" 2m transmitter-receiver; Gonset 2m VHF power amplifier. Anyone with information concerning this equipment is requested to contact the Wichita Police Department, 115 E. William, Wichita KS 67201.

RADIO SOCIETY OF BERMUDA Rules 1971 BARC Contest

1.*Contest Period:*
PHONE: ØØØ1 GMT May 15 toØ2ØØØ GMT May 16th 1971.
C.W.: ØØØ1 GMT June 19th toØ2ØØ GMT June 20th 1971.

2.*Bands*
The following amateur bands will be used: 3.5, 7, 14, 21 and 28 MHz.

3.*Exchanges*
Amateurs in the U.S., Canada and the U.K. will transmit a two figure number representing the RS report plus their State, Province, or County respectively. CW participants will transmit a three figure number representing Amateurs in the U.S., Canada and the U.K. will transmit a two figure number representing the RS report plus their state, province, or county respectively. CW participants will transmit a three figure number representing the RST report plus their state, province or county respectively. VP9 stations will give RS or RST reports plus Parish. (U.K. stations may use the official RSGB list of abbreviations for U.K. counties.) U.S. and Canadian stations may exchange reports with U.K. and VP9 stations only. U.K. stations may exchange reports with U.S., Canadian and VP9 stations only.

4.*Points*
Each contact must be complete and will count three points. No crossband or cross mode contacts permitted.

5.*Scoring*
The score for U.S., Canadian and U.K. stations will be the number of completed contacts times three points, times the total number of Bermuda Parishes worked on each band used. For example: A U.S. station having made a total of 500 contacts with U.K. and Bermuda stations and the following Bermuda Parishes: 28 MHz- 3 Parishes; 21 MHz- 6 Parishes; 14 MHz- 3 Parishes; 7 MHz- 2 Parishes; 3.5 MHz- 2 Parishes, the score would be 500 contacts times three points = 1500 points times 16 Parishes = 24,000 points final score. A U.K. station completing 500 contacts with U.S., Canadian and VP9 stations would score in exactly the same manner.

6.*VP9 Local Scoring*
Bermuda stations will receive three points for each completed contact. The VP9 multiplier will be the total number of States, Provinces and Counties worked on each band used.

7.*Equipment*
Any number of transmitters and receivers will be allowed and competitors may use the maximum power permitted under their license. However, all stations participating must be single operator only.

8.*Presentations*
Round trip air transportation for two will be provided for each winner plus one week's accommodation at one of Bermuda's leading hotels to enable the overall winners to attend the Radio Society of Bermuda's Annual Banquet to be held on October 21st to receive their awards.

9.*Awards*
A trophy will be presented to the winners of each section (U.K. and N.A.). A certificate signed by His Excellency The Governor of Bermuda will be sent to the highest scoring station in each call area as follows: U.S.A. and Canada: W1 through WØ and VE1 through VE7 including V). U.K.: G, GD, GM etc.

10.*Log Instructions*
Keep *all times in GMT* and all contestants to compute their own scores and check logs for duplication to assist the Contest Committee. Print name and call on each log. All contestants must sign a statement that the rules and regulations have been observed.

11.*Eligibility*
Contest winners, regardless of section won, are ineligible for a period of two years..

12. Should there be a tied score. the decision of the Contest Committee will be final. All logs must be received

home county.

Frequencies: CW – 1810, 3590, 7060, 14060, 21060, 28060 kHz. SSB – 3975, 7260, 14290, 21410, 28600 kHz. Novices,– 3718, 7175, 21110 kHz. Try 160 meters at 0300 GMT. Try 10 meters on the hour and 15 meters on the half-hour during daylight hours.

Your log should show date and time of contact in GMT, stations worked, exchanges sent and received, band used, type emission, and multipliers claimed. Checklists will be appreciated.

Include a signed declaration that all contest rules and operating regulations were observed and mail your entry to CARC, Inc., Attention: John T. Laney, K4BAI, 1905 Iris Dr., Columbus GA 31906. Entries should be postmarked no later than June 7. Please send a self-addressed, stamped envelope for a copy of the results.

FCC PETITIONS FOR RULE MAKING FILED

RM-1723 George E. Cushing (W4QVJ)
Hollywood, Florida 11-25-70
Request amendment of the Amateur Radio Service Rules to eliminate telephony between 14.200–14.225 kHz.

RM-1724 R.A. Cowan (WA2LRO)
12-7-70
Port Washington, L.I., New York
Request amendment of the Amateur Radio Service Rules to: (1) Reduce General Class operator examination code test from 13 to 10 words per minute; (2) Provide Technician Class operators telegraphy operation in Novice bands, and (3) Restore Novice telephony privileges in the 145–147 MHz band.

RM-1725 Ken W. Sessions, Jr. K6MVH
12-7-70
Peterborough, New Hampshire
Request amendment of the Amateur Radio Service Rules to drop the requirement that the station licensee continuously monitor and maintain control of a "repeater" if automatic turn-off and fail safe devices are provided and if tone access and control is provided on the repeater receive frequency

RM-1729 Gary A. Stilwell (W6NJU)
Canoga Park, California 12-17-70
Request amendment of the Amateur Service Rules to provide expansion of the 3.8, 7.2, 14.2 and 21.25 MHz telephony bands "to more equally distribute frequency allocations between the Extra, Advanced and General class of operator licenses."

ALBERTA

The radio clubs of Southern Alberta are hosting the combined 37th Annual Waterton-Glacier International Hamfest – Alberta Hamfest at the beautiful Waterton Lakes National Park, July 17–18, 1971.

ROCK RIVER

The fifth Rock River Hamvention will be presented by the Rock River Radio Club of Dixon, IL on May 16 from 9:00 a.m. to 5:00 p.m. at the Lee County 4H Center, Amboy, IL, which is located one-half mile east of the intersection of Highway 52 and 30. Concrete-floor buildings are under contract this year, so no dust problem. Advanced tickets $1.50, at the door $2.00. Plenty of parking and food. Plenty of tables, all under roof. Campers welcome. Talk-in frequency is 3.950 and 50.4 MHz. *(Ed. Note: No 146.94 FM?)* For tickets send check or money order to Carl Karlson, W9ECF, Nachusa, IL 61057.

SYRACUSE FEST

On April 17, 1971, the RAGS hamfest will be held at Song Mountain off Exit 14 of Interstate 81 south of Syracuse, New York. This get-together serves the Northern, Central New York and Southern Tier amateurs well, and serves to promote all phases in the hobby of amateur radio.

The hamfest planners have been organizing for a long time to assure the success of this. If you can make it, DO make it!

CANCER VICTIM AIDED BY HAMS

On September 21 Marshall Jones, WA2MID answered YU1BCD in Pancevo, Yugoslavia. YU1BCD needed help. A five-year-old girl who had just been operated on for cancer was in desperate need of a new drug that was available only from U.S. sources. Marshall called Dave Marks (W2APF) who has had a great deal of experience in assisting in other similar situations. Uncle Dave started things going. The first shipment was lost, but finally the drug was delivered. The happy ending of this story is that the little girl is doing very well, and will soon be walking again, thanks to Marshall, Uncle Dave, and a great many others who helped.

1971 AMATEUR ALLOCATIONS

Technician

CW & PHONE: 50.1–54.0, 145–147, 220–225, 430–450, 1250–1300, and up.

GENERAL

CW: 1800–2000, 3525–3800, 3900–4000, 7025–7200, 7250–7300, 14.025–14.200, 14.275–14.350, 21.025–21.250, 21.350–21.450, 28.0–29.7, 50.1–54.0, 144–148, 220–225, and up.*

PHONE: 1800–2000, 3900–4000, 7250–7300, 14.275–14.350, 21.350–21.450, 28.5–29.7, 50.1–54.0, 144.1–148, 220–225, and up.*

ADVANCED

CW: 1800–2000, 3525–4000, 7025–7300, 14.025–14.350, 21.025–21.250, 21.275–21.450, 28.0–20.7, 50.1–54.0, 144–148, 220–225, and up.*

PHONE: 1800–2000, 3825–4000, 7200–7300, 14.200–14.350, 21.275–21.450, 28.5–29.7, 50.1–54.0, 144.1–148, 220–225, and up.*

EXTRA

CW: 1800–2000, 3500–4000, 7000–7300, 14.000–14.350, 21.000–21.450, 28.0–29.7, 50.0–54.0, 144–148, 220–225, and up.*

PHONE: 1800–2000, 3800–4000, 7200–7300, 14.200–14.350, 21.250–21.450, 28.5–29.7, 50.1–54.0, 144.1–148.*

Late Reports from IARU Region I News

GENEVA

The IARC convention took place during the latter part of 1970. The technical sessions were held in the ITU council chamber. Representatives of the following national societies were present: ARI, ARRL, DARC, Radio Club of the German Democratic Republic, Radio Amateurs Libanais, PZK, REF, RSGB, SRJ and USKA.

The convention was opened on the Friday evening by R. E. Butler, Deputy Secretary-General of the ITU. A reception was held at which a number of delegates from an IFRB seminar were present.

The technical sessions were held under the chairmanship of G2BVN and the following speakers were heard: F3FA, DL1XJ, DL1FL, DM2HGO, I1BAY, SP5HS, YS1AG and YU3BH. In addition, a paper from ZL2AZ was read by HB9AJU and there were two showings of the ARRL film "The Ham's Wide World."

50 MHz BEACON STATION

Canadian station VE8YT, located at Clyde River (on the north coast of Baffin Island, some 1700 miles north of Ottawa), went into full-time operation on October 4. This beacon operates on 50.098 MHz with an output power of 65W into an omnidirectional antenna.

Reception reports are requested; these should be sent to Larry Kayser, 59 Westfield Crescent, Ottawa 5, Canada.

The beacon has been heard on two occasions by TF3EA and is expected to be heard in Europe during unusual propagation conditions.

by the Contest Committee of the Radio Society of Bermuda NOT LATER THAN July 31st 1971.

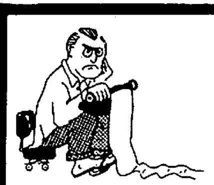
The following abbreviations of Parishes will be used on CW.

SANDYS . . . . SAN
PEMBROKE . . . . PEM
SOUTHAMPTON . . . . SOU
HAMILTON . . . . HAM
ST' GEORGE . . . . GEO
DEVONSHIRE . . . . DEV
WARWICK . . . . WAR
SMITHS . . . . SMI
PAGET . . . . PAG

Further information can be had by writing the Radio Society of Bermuda, P.O. Box 275 Hamilton, or by writing the Contest Chairman, P.O. Box 73, Devonshire, Bermuda.

Ham Radio Mag Noses Into 3rd Place

Congratulations are, it is reported, in order to Ham Radio magazine for their recent passing of CQ in the circulation battle. Ham Radio has been doing well with its completely noncontroversial editorial policy and its fare of construction projects aimed at the engineering level amateur. Is it a sign of the times to find so many amateurs becoming interested in the serious technical aspects of amateur radio, apparently losing interest in the operating news, contest reports, and columns which have been the mainstay of CQ magazine?


NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

THE INSTITUTE?

The recent editorial going into some of my proposals for improving the League brought considerable favorable mail, including quite a number of requests that I reconsider starting the Institute of Amateur Radio again.

There are undoubtedly quite a number of readers who are a bit hazy on how the Institute started, how it fared, what it did, and what happened to it. Did it really take in tens of thousands of dollars that I absconded with? Was it really the threat to the League that some HQ people thought it was? Did the Institute really help amateurs in legal difficulties with grants of money? Did the Institute really register as a lobby with congress? The Institute first started back in 1962 when it was incorporated in New Hampshire as a nonprofit membership corporation. The original purpose of the Institute was to promote amateur radio and provide a working club for amateurs who were interested in group travel. The Institute was promoted in 1963 primarily as a means for group traveling to foreign countries and this culminated in October 1963 when the Institute ran a guided tour to Europe for 73 amateurs and their families.

The tour was a resounding success. We went to London, Paris, Geneva, Rome, and Berlin. We met with the local amateurs in these cities, got together for dinners, parties, and other events with them. We even organized an audience with the Pope while in Rome!

In order to prove that all monies coming in were being strictly accounted for we published the list of the Institute members in 73. Thus anyone could easily calculate the Institute income. Also, if any amateur sent in money and found himself not listed he could take us to task for trying to hide income. We felt that this was reasonably foolproof as protection for the membership.

Since our primary purpose was to lay the foundation for a lobby in Washington one of our first moves was to subscribe to a press clipping service so we would get copies of all newspaper and magazine articles touching on amateur radio. With this valuable material we put together newsletters which were sent to all senators and representatives in Washington as well as all state governors.

As these newsletters continued to extol the virtues of amateur radio and point to specific instances of amateurs saving lives, getting the medicine through, and helping in all sorts of emergencies, the response from the congressmen began to escalate. We offered them form letters to help them with their problems with constituents pressuring them on CB and ham matters . . . and these forms were requested in satisfying quantities. We made sure that they understood the difference between amateur radio and CB, a distinction that is fuzzy or nonexistent with much of the general public.

A well known and respected amateur in Washington volunteered to Dave and 73 were no match for the organization against them and eventually the money ran out. Dave gave many times over the few thousand dollars he earned from the Institute with his time and devotion to it. An accounting was made to the members of all the funds received by the Institute, with 73 making up the deficit at the end.

The Institute has not been permitted to die entirely. I still file with congress as a lobby for amateur radio and, when I can, I personally go to Washington and see as many people as I can in the limited time I have available. We have been reprinting the more interesting news pages from 73 and sending them to congressmen. Much more can and should be done, but we are running 73 with a skeleton crew and this means more work for everyone than they can handle. Even so, we are just skinning through the present depression, trying to put out the biggest magazine we can, but still making sure that we stay in business.

How many amateurs supported the Institute? Certainly there must have been a few thousand that sent in their money for so valuable a program. In fact, the total number of founding members numbered about 600. The total income received from these members was $6030.

Did this six thou find its way to my pocket? What happened to this grand sum? Well, $500 was spent on the legal defense of WØJRQ's tower case. Note that the ARRL has yet to ante up one single dollar for an amateur fighting a legal case which could affect all of us. The case came out successfully and we had a nice letter from WØJRQ thanking the Institute for helping him over a very rough spot. Loss of the case could have been catastrophic for amateur radio.

The clipping service and the newsletter to congress accounted for about $2000 of the funds. Another $900 went for membership certificates, membership cards, (and they were

the FM scene

by K6MVH

FM is where it's happening right now. Have you had the chance to look over the repeater directory in this issue, and possibly compare it with the directory published in 73 one year ago? If so, you will have noticed that within that one-year period, the actual number of operating repeaters in the U.S. and Canada has doubled! But another interesting fact is that the average number of users per repeater has also increased substantially this past year, with the result that there are nearly three times as many people using FM today (as compared with estimates for one year ago).

A year ago there were two companies in the FM transceiver business: Varitronics and Galaxy. Today there are twelve, and more coming. And today there is a peripheral industry supported by the FM crowd – people who make code identifiers for repeaters, special antennas, rf power amplifiers, tone encoders and decoders, schematics. Then there are the commercial FM surplus dealers, specializing in the "amateurization" of such well known breeds as Motorola, RCA, GE, and Aerotron.

From outward appearances, it would seem that FM and repeaters are shaping the future and destiny of amateur radio's highest popular frequencies – this is something for which we can all be grateful, because growth means activity and activity means growth. And a growing, active band won't be snatched up because of nonuse. Now, for the first time in more years than is comfortable for any of us to remember, ham radio is on the upswing. *Isn't that groovy ?*

International FM

Repeaters aren't strictly an American phenomenon. Reports keep coming in about interesting repeater developments in Europe. The DLØSTA machine, for example, in Stuttgart, is reported to give excellent coverage over a very wide area from its unique location atop the famous needle tower there.

If all goes according to plan, Wayne and I will get the chance to visit some of the European repeaters next month. I want to talk with the representatives of the major FM clubs to learn what they're doing in the way of standardization of tones, frequencies, control methods, etc. If possible, I'd like to offer assistance and lend publicity to their efforts, so that they can avoid some of the problems our own early efforts encountered. It would be beneficial also to maintain some degree of compatibility between European and American systems, so as to allow a maximum interchange of ideas.

If the trip goes off as scheduled, I should be able to return with plenty of color slides to share with American radio clubs. And the next repeater directory that 73 publishes will be able to reflect the FM action taking place all over the world. With this European visit, I will try to set up a line of communications with the European repeater principals so that we in America can keep abreast of the growth of repeaters in those western countries.

Something For Free

As a promotional giveaway for SAROC, Wayne printed a flock of

With the submission of the petition for punishment licensing by the ARRL in late 1963 I found that the pressure was really on from 73 readers for the Institute to become more than just a travel club. The membership fee had been set at $1, which just about covered the cost of a membership card and certificate, leaving little for any other work and none at all for salaries. If the Institute was to be of any value to amateur radio I felt that it must fulfill some of the functions that the ARRL refused to accept as responsibilities such as a Washington lobby, financial help to amateurs fighting legal suits which could affect amateur radio seriously, public relations for amateur radio, etc.

This was a big bite and would need more income than seemed reasonable to expect if it were to be effective. After discussing this with quite a number of influential amateurs, individually, as well as at clubs and conventions, I decided that it was worth making a try. But would the amateurs support a new club? Complacency and apathy were running deep and I realized that I was gambling that there were enough amateurs seriously interested in the future of the hobby to support what I had in mind.

We decided to set the yearly membership fee at $10. This was high compared to the ARRL, but then the Institute was intended to provide a lot more for the amateur than the ARRL had to offer. Compared to national clubs in other fields the $10 was small. We felt that the propsect of a Washington lobby, legal help, P.R., and other programs would be of far more value than the League's offering of a code practice station, bulletins, and an almost phantom organization. And besides, we did have the makings of our own "W1AW" for code practice and bulletins, if that was wanted by the membership.

The response to the $10 membership was not encouraging. Several hundred amateurs supported the program. help as the contact man for a Washington lobby. He was registered by the Institute with congress, as required by law, as an official lobbyist for amateur radio . . . the *first* man ever to be so registered!

Though the response to our pleas for membership were disappointing, there was enough money to send out the newsletter to congress as long as no salaries were paid. I set the type for these, laid them out, pasted them up, made the negatives, stripped them into flats for making plates, made the plates, ran them through our small offset press, folded them, addressed the envelopes, and mailed them. It was one hell of a lot of work, but I didn't know any other way to get it done.

Then the attack began. Letters began arriving from amateurs saying that ARRL directors had been to their clubs and ridiculed the Institute. WARN, an underground bulletin allegedly financed by the League, was sent regularly to every amateur listed in 73 as a member of the Institute. WARN ridiculed anyone stupid enough to support the Institute, suggested improprieties and went on at unbelievable length repeating the ARRL line that only one national organization was needed and that anything else was bad for amateur radio. WARN was sent to just about every amateur club in the Country affiliated with the League.

The attack was successful. The trickle of memberships dwindled to a dribble. This unfortunately coincided with a long period of sickness on my part when I was totally unable to work. The Institute directors worked hard to find someone to replace me as acting secretary of the Institute, finally selecting a well known and active amateur, Dave Middelton (W7ZC), an ex-ARRL director! Dave, with the help of his wife, working for a small salary to keep the Institute going, worked hard to overcome the campaign against the Institute, keeping information going to congress. spectacular laminated cards), stationery, envelopes, stickers, buttons, etc. With the exception of the purchase of some used equipment for Dave (typewriter, file, Ditto machine, photocopier, etc.) most the remainder went for the secretarial expenses at W7ZC.

Over a period of about three years the Institute did rather well with the little money available. The ARRL spends over double that every month on nonpublication expenses . . . to what advantage? The Institute did help to win an important tower case . . . it did keep a representative in Washington . . . it did send frequent mailings to congress. On the negative side, it probably caused the League to spend up to $20,000 of the membership money in fighting the Institute.

Since the League is able to defeat any new organization that comes along by spending whatever is needed to stop it, there seems little use in trying to go that route. The Institute was organized explicitly to augment the League by performing functions that the League had no intention of performing . . . and still it was effectively killed off. Any threat, no matter how remote, must be stopped.

NEW EUROPEAN HAM TOUR IN OCTOBER

Many of the amateurs that went on the 1963 tour of Europe have asked that we again organize a trip. We came close a couple of years ago, but emergencies put a halt to our plans. We are again thinking in terms of a possible trip this fall to Europe . . . and perhaps one next spring.

The tour would start in early October and is tentatively scheduled to stop at Paris, Munich, Zurich, and Amsterdam. October was chosen for several reasons . . . Europe is still warm at that time of year but not hot . . . not too rainy . . . the summer crush is over . . . off-season airline and hotel rates save considerable money.

We are planning on a get-together with amateurs in each of these cities so we can get to know them.

Paris . . . what can I say? The Lido . . . the flea market . . . the left bank . . . the Eiffel Tower . . . The Champs-Elysées . . . the dress boutiques for the wives . . . and the great friendship of the French amateurs. Munich! Remember that the Munich Octoberfest is world renowned . . . a three-week-long party with new wine, and incredible amounts of beer. Add to that a visit to the Nymphenburg Palace . . . and other great sightseeing spectacles. Zurich . . . inexpensive watches . . . your own numbered Swiss bank account . . . tiny back streets with fascinating stores . . . toy shops . . . woodcarving . . . and a gourmet paradise of fondue bourguignonne and other specials. Amsterdam . . . the city of canals . . . more than Venice! Great food . . . Rembrandt's home . . . Anne Frank's house . . . inexpensive jewelry . . . and chocolate!

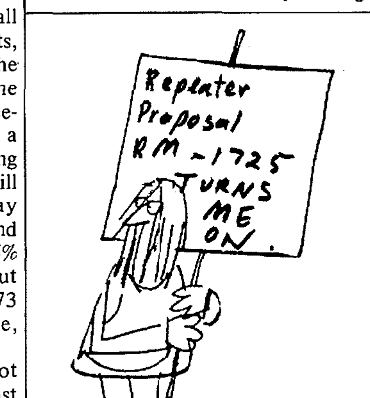
Our tour will be limited to 73 amateurs (including their wives). The cost of the tour, including jet to Europe, flights between all cities, all hotel accommodations, breakfasts, and transportation to and from the airports probably will run on the order of $800 per person for a three-week trip. We are going to have a wonderful time . . . how about joining us? A $200 deposit per person will hold a reservation for you. You may cancel at any time with a full refund up until August first and with a 75% refund up until September first. But remember, we can only handle 73 people; so it has to be first-come, first-served.

Lunches and dinners are not included on the assumption that most people will want to have their hotels and such taken care of but will want to be free other than that so they can go sightseeing, visit local amateurs, experiment with interesting restaurants, and such. I have a good deal of experience in these cities, and will be on hand all along the line to advise and make suggestions as to what to see and do.

The hotels will be good, but not those darned imitation American hotels which take all the European flavor out of travel.

Best of all, we will all be amateurs and traveling together . . . and that is what makes the real fun. How about it?

miniature bumper stickers for FM'ers. The bumper stickers bear the words, "Listening .94," "Listening .82," "Listening .76," etc. He printed a lot of these things and we have plenty of them left over. For a limited time, 73 will be making them available to anyone interested at no cost. Just send a self-addressed stamped envelope to 73, Peterborough NH 03458, saying what frequency you want to advertise. These have been printed up for all standard FM channels, but the supply is limited, so we can offer only two to a customer. Don't forget to specify frequency, because we're not mind readers. Also, please understand that these are on a first-come, first-served basis; we probably won't reprint them when we run out. We have stickers for .70, .73, .76, .82, .85, .88, .91, and .94. If you want more than two stickers for any one frequency, don't ask. Wayne thinks we'll get maybe three or four hundred orders. I think we'll get a couple of thousand. Let's show him, shall we? Send in those SASEs now, before you forget.



WTW ROUNDUP

David Mann K2AGZ

The WTW program has not kept current for a very long time, neither from the standpoint of sufficient coverage in these pages, nor on the part of those hams who formerly showed interest in it. Above all, WTW has suffered from neglect on the part of the WTW editor, namely myself. There are many reasons for the situation, and while it might be of some value to examine them, there would be little point to it, unless for the purpose of avoiding the same problems in the future.

One thing is abundantly clear: unless immediate steps are taken to remedy the ailment, the patient is in danger of succumbing. For that reason we are going to take a gander at it, make some significant changes, and see if we can't pump some life into the old bones.

A number of participants have complained about the overly large certificate, and have suggested that it be reduced to the same dimensions as the DXCC award. This shall be done as soon as the printer can produce them. Also, all prior certificates will be replaced with new ones at my expense. These will incorporate updated scores. Together with the new certificates, each recipient will receive a set of report forms, to be filled in and filed on a quarterly basis, so as to bring all scores up to date for inclusion in the WTW rolls, which will be printed in the magazine four times yearly.

There will no longer be separate certificates issued for 100, 200, and 300 or more countries, but endorsement stickers instead. After the basic 100 country award is issued, all subsequent totals will be covered in 20-country increments, to be attached to the certificate by the holder himself. These endorsements shall be issued strictly on the up and up. You just never can tell!

Of course, it goes without saying that any acccounts of such DX operations will also be welcome. We would like to include them, for they help to encourage others to operate similarly. In line with this, we are also interested in hearing whatever items you might manage to pick up in your on-the-air contacts with stations planning unusual or off-the-beaten track DX operations.

Please bear in mind, the success of a DX feature depends in large measure upon the cooperation and participation of contributors, for without them it becomes a one-man show, lacking in sufficient breadth and scope. I will rely upon your interest and willingness to pitch in with whatever items you can send in.

Hopefully, we can make up all the lost ground in the WTW program and get it going again. I can assure you that if sincerity of purpose and energy count for anything, WTW will be a healthy and vital program . . . one in which you will be happy to participate.

After the long, long wait for Laccadives to appear, it finally showed up over the long path on 20 meters. The boys were transmitting below our band and listening between 14.270–.300. I had a miserable case of laryngitis, but spent two days at it, and finally got a contact. I believe the operator at the time was Venkat, signing VU5KV. Signals were not of the best quality. As usual, the long-haul stuff showed up at around dawn, here on the East Coast, and the band dropped out after a couple of hours. At his best, he was about 5/7 here, although from some folks' reports, the signals were much better than I could copy. Or was it just a case of gilding the lily just a trifle?

The following stations appeared on the last published WTW list, several months ago. They are, by no means, the only certificate holders . . . several of them have updated their scores, and have won awards on different bands. Although the list as it appears here is not fully accurate, it is as good a starting place as any to pick up the award program where it left off. It is hoped that by the time the next list is published, it will be up to date as to scores, and those stations which are omitted inadvertently will be included.

7 MHz CW 100
W4BYB
W3WJD
W8ZCK
VE3BLU
W5AB

14 MHz CW 100
WB6NWW
K4CEB
W8EVZ
W4CRW
WA2DIG
K8IKB
WB6SHL
W9HFB
W5ODJ
WB2TKO
WA9KQS
W1ETV
K5BXG
K4ASU
WA6GLD
W2UGM
WA2LRK
K4TSJ

14 MHz Phone 200
W4NJF
W3DJZ
K3YGJ
K6CAZ
W3AZD
XE2YP
WA2SFP
WA5LOB

CN8FC
WAØOAI
WØSFU
W4HA
ZL3MN
W3NKM
W8WAH
VE3ELA
WA4WTG
W6MEM
WA2EOQ
WB6RMZ
K5BXG
WA4OPW
W8BVF
W6OHU
W8FPM
K2QOU
VK3XO
VE6AKV
K5TGJ
K4VKW
SVØWL
W3SEJ
WB2NSG
K4GXO
3C5QK(VE5)
W8ROC
W1EED
FR7ZG
OE2EGL
W1PCCD

21 MHz CW 100
VE6TP

As you can readily see, I have made no effort to list these stations by the number of credits, since we intend to bring all scores up to date in time for inclusion in the complete list which will appear in a couple of months. Also, those stations who were previously listed for WTW-100, and who subsequently achieved WTW-200 have received dual listing. In future, any station which upgrades into a higher category will automatically be deleted from the first list.

As stated before, all lists will be examined for countries worked in 1966. These must be worked again, if credit for them is to be maintained. If the country no longer exists, it will simply be credited to your overall total (1st figure) and another country must be worked to bring the current figure (2nd) up to snuff.

Drawings for the new certificate are on the board and will be sent to the printer shortly. They will be sent out as soon as possible. Please be patient, and bear with us, and *please* don't send in any inquiries, corrections, or updated scores until I give word that we are ready to handle them. Okay?

73/Gud DX de K2AGZ■

Caveat Emptor?

MANUALS – $6.50 each: R-390/URR, R-390A/URR, USM-24C, BC-639A, SP-600JX, BC-348JNQ, URM-25D, TS-497B/URR, ARR-7, OS-8C/U, CV-591A/URR, BC-779B, TS-186D/UP, FR-5/U. S. Consalvo, 49055 Roanne Drive, Washington DC 20021.

VIRGINIA STATE ARRL CONVENTION. May 22-23, War Memorial Building, Vinton, Va. Rt. 24 (Off 460 – in Roanoke County. Saturday 6 PM Registration & Social. 8:30 PM Firstnighter Round & Square Dance.

"I LOVE THE BANJO" my latest Stereo LP 36 tunes Dixie to Classics banjo solo $4.95 PP. Richelieu, The Banjo Man, W9JS, 215 S. Washington, Wheaton IL 60187.

TRANSISTOR CHECKERS. . .Portable, check surplus specials fast. Simple plug in test tells NPN PNP good nogood. . .$5 postpaid. W6PJN, Box 611, Clovis CA 93727.

SALE – 75A4 $325, C.E. 100V new 2AP1 scope tube excellent condition $300. FOB Burt Weidenhamer K4DVT, 3761 18th Ave, N., St. Petersburg FL 33713.

GET YOUR "FIRST!" Memorize, study – "1970 Test-Answers" for FCC First Class License, plus "Self-Study Ability Test." Proven. $5.00. Command, Box 26348-S, San Francisco CA 94126.

MOTOROLA PT-300 5-WATT WALKIE TALKIE. Two icad batteries, charger. .34–.76; .34–.94; .94–.94; .34–.76, .94; .94–.76, .94. Excellent condition $300. Robert Gold W9GBD/8, 6731 Rushton, Dayton OH 45431.

HEATH TX-1 $120; HW-32 w/100 kc cal. & mike $109, HP-13 $50, HP-23 $40, Heli-whip ant. $20, ALL 4 items $205, EXCELLENT CONDITION; Lincoln 6 Meter Tx-Rcvr $15; HQ 170C w/clock $100 or best offer, Electronically FB; Novice rig 40/80 xmtr CW-AM 25 watt $25. FOB Tom Gundlach WB4NPU, 1535 Monte Carlo Court, Merritt Island FL 32952.

SELL OR TRADE, HT 40 transmitter SX71 Rcvr. 2K. PEP Linear. Interested in 2 meter FM gear, no junk. E. DeCobert, 609 Henrietta St., Gillespie IL 62033.

HIGH VOLTAGE DIODE STACKS + surge capacitors. Long=48, short =32 – 1500 PIV diodes. Get 300/600/1200 ma. Insulated Mounting. Long $6, short $5. Quantity discount. WA5UNL, 5429 46th, Lubbock TX 79414.

sued upon receipt of the aforementioned quarterly reports. Only submissions made in this prescribed manner will be considered for endorsements or listing in the quarterly WTW standings.

Apart from these changes, there is one other. Two new categories will be established as a permanent, ongoing part of the program. WTWM, consisting of contacts with DX mobile stations, and MWTW, consisting of DX contacts from your mobile. In all other respects, the same rules apply . . . one band, one mode.

We are now approaching a point when the five-year limitation on country longevity is being implemented. You will recall that one of the regulations in the program calls for the deletion of those countries worked prior to five years previously. They have to be worked again in order to qualify. Of course, this means that those countries which no longer exist will simply be dropped from the total score. We plan, therefore, to establish a listing similar to DXCC, in which two figures are given, the first one being the total countries worked including deletions, and the second one being the current score, counting only valid credits.

As to additional DX activity in the pages of 73, we are going to institute a regular DX feature, consisting of appropriate DX items, QSL information, advance notice of DXpeditions, etc. We solicit items of DX interest from the readership, so that we may be as efficient as possible in covering the full picture. And, speaking of pictures, we also solicit as much illustrative material as possible. If you operate from a vacation DX QTH, using a reciprocal license, or from the shack of a resident ham's location, make sure that you can get some good quality snapshots of the action, so that we can include it in our monthly column. If you can manage to include some local color (preferably in bikinis) so much the better. Who wants to look at pictures of yagis and quads, anyhow?

The annoying thing about an operation like this one, where the DX station sits outside our band and listens up above, is the growth of a mob of self-appointed monitors, riding herd on the DX transmit frequency. This can be pretty unnerving. After all, in these days of transceivers, it is very easy, in the heat of the chase, to forget to use the external vfo and wind up calling on the wrong QRG. The moment this happens, at least two dozen guys, all with kilowatts, chime in to tell the guy he's out of the band. In some cases they tell him a lot more than that, too. The resultant din is much worse than the small amount of QRM caused by the fellow who forgot. But I suppose it gives some guys with big mouths something to think about while they talk! Most of the time, the stations which get on the wrong spot by mistake rectify it promptly, but there were a couple of times when I heard them continue calling for ten minutes after having been told to QSY up the band. I guess some guys are just stubborn.

Well, anyway, it felt good to polish off this one, especially after it had been scrubbed a few years ago with those other four rare ones.

We keep hearing persistent rumors about three of the most wanted countries, Bouvet, Clipperton, and South Sandwich. To the best of my ability to track these down, they remain just rumors. There is no evidence to suggest anything more than wishful thinking and a vivid imagination. Some guys suffer from a pathetic willingness to substitute idle chitchat for cold, hard facts.

If and when these or other items materialize, you will be advised of it here. Meanwhile, if you happen to hear anything from a guy claiming to be on one of these rare spots, work him first and ask questions later. I have had a number of experiences like this, when everybody called the stations phonies and pirates, and then subsequently a QSL showed up in the

WB2WOU
W1MMV
K8YBU
PY3BXW
W6MEM
WB2NYM

14 MHz Phone 100

W4NJF
W5KUC
W3DJZ
W4CCB
W2PV (WA2SFP)
K6CAZ
WØNGF
W3MAC
K1SHN
K8IKB
W6YMV
W1SEB
WA5LOB
W4TRG
WB2NYM
KP4RK
W1MMV
WA9KQs
WA4WIP
W4FPW
K9OTB
W4JVU
WA4RMX/DL5HH
W4FPS
K3YGJ
VE6AKP
K2BQO
W3AZD
WA5DAJ
OZ3SK
ZL3OY
K4RZK
W4OPM
W2PV (WA2SFP)

28 MHz Phone 100

W2PV (WA2SFP)
W4GJO
W5YPX
WA5LOB
W2VBJ
WA5DAJ
W6MEM
WB2RLK
W1PCD
W8WEJ
W1EED

WB2UDF
WA6GLD
WØRRS
WA9OTH
WØDAK
WA9NSR

21 MHz CW 200

W4OPM

21 MHz Phone 100

WA2FQG
WA2SFP
K9PPX
W6YMV
WA4WTG
W9NNC
WA5DAJ
W8WRP
WAØOAI
WB2OBO
WA5LOB
W6MEM
K4VKW
WA1EUV
W2VBJ
K5HYB
WB2RLK
WA8FVK
W4SYL
W1EED
W1PCD
WA7BPS

21 MHz Phone 200

28 MHz Phone 200

W2PV (WA2SFP)

LETTERS

Article Index

In researching amateur radio articles via December issue indexes, I find that your Dec. 70 Index is possibly the *worst* in all of hamdom. Please change! Thank you.

Alfred A. Assaiante
213 St. James Pl
Merchantville NJ 08109

All right.

. . .Ken

160 Meters

Why don't you get out ahead of those other magazines and give us some articles on 160 meter homebrew gear of all kinds? A good transistorized receiver, QRP xmtr, and anything else that would fit in. There are still some of us who like to homebrew yet. And this is where I think we have lost our fire in ham radio. A shack full of homebrew gear will build up far more excitement than a shack full of commercial gear. Do enjoy the editorials and I think you've got a lot of the fellas thinking.

Lawrence H. Moore W7NJU
417 West 5th
Jerome ID 83338

We can't buy articles that you fellas don't write.

. . .Ken

Lifer

Enclosed is check for lifetime subscription to 73. 73 is the best all round amateur magazine on the market. Keep up the good work.

Thomas W. Barefoot WN4PVM

Straighten Up!

What's with all the sideways-printed material in the front of the magazine? I've been able to ignore it up to now, but with the Contents (& W2NSD/1) Small, efficient, portable.

Perhaps: Take it all with you with a Ford Bronco 4-wheel-drive vehicle.

Now, while not all of Mr. Ford's or Mr. Honda's merchandise would be advertised, there are a few select products within these and other fields that most certainly would be interesting to radio amateurs.

You also seem unhappy that Collins Radio does not deem your magazine worthy of advertising dollars. Try this: First, discontinue all of those wonderful construction articles. After all, how do you expect one to buy Collins, when there are all those marvelous, current, state-of-the-art construction articles there? *Second,* in order to fill the magazine, initiate columns of Who's Who in DX, DX standings, and other trivial details, such as listing the top stations in a particular contest. This designed to foster in the readership an attitude of: "Gee, Joe Blow down the street has one more country than I do, I'd better get a Collins." "Hey, Al Pal across town worked more stations than I did during the last contest, I'd better get a new Collins." "Oh, boy, I slipped down in the DXCC standings, I'd better get a new Collins linear." *Third,* in my program, cancel my subscription, as when your magazine deteriorates this far, I will no longer be interested in it.

I have a poor opinion of Collins. I have never seen a demonstration by Collins where they did not cast aspersions on all amateurs who did not buy Collins equipment, and especially upon those who choose to build their own rigs. This includes the Cleveland Hamvention, the Dayton Hamvention, and guest speakers at our own local radio club.

At one, I witnessed a demonstration where the demonstration was a "homebrew" transmitter of innovative design, and the "operator" actually blew it up (a small fireworks display) and commented, "Well, if I'd bought Collins, I wouldn't have this trouble." Whereupon he launched into a lengthy speech about the wonderful Collins radios.

I sincerely hope you will find the couple of years, we'll have \$60–70 5W 220 MHz transceivers for the hobby band. In fact, there will probably be a bigger technical advance with RM-1633 than even 2 meter FM.

As far as licensing goes, I'm a General and I'll be going for Advanced in a few months. I'm in favor of incentive licensing if for no reason than to have a more competent ham fraternity. I know I'd have never gone to the trouble to get an Advanced or Ex unless it was necessary. In fact, I'd like to think of the hobby band as sort of a "renewable sub-Novice." Maybe with the additional income, the FCC could get realistic on all license fees and back off the stiff tariffs.

Still is the best construction mag for my book. Keep up the good work. Oh by the way, the worst thing that could happen to 73 is to merge it with QST!! Just improve QST if anything.

Ed Manuel WA5GZD
7118 Kingsway
Houston TX 77017

I think 73 mag is the greatest, and if Wayne ever starts another radio organization or becomes director of ARRL, I'll be one of the first to join. 73's Advanced and Extra class study guides are outstanding.

Joseph E. Falletta Jr.
WB6UDO

Kill the Umpire!

How about looking around for another editor. Frankly, the magazine is not too interesting to a lot of us readers. It seems you are leaning more toward the VHF and many of us could care less for high frequency. RTTY UGH! The mag is not as good as it once was but then again QST is worse, and I have been subscribing to it for almost 50 yrs. On the other hand, maybe it is me; when you are 65 and retired, things seem to bother you more, you are not so permissive.

T. E. Burmeister W8BSS
862 Quarry Dr.
Cleveland OH 44121

Sorry, OM. 73 is trying to appeal to the young and active. So I can't see why you don't really dig QST.

. . .Ken

Novice and have been so for almost a year now. Being very interested in amateur radio I feel that I am about ready to pursue the General class license. Between my electronic background, your study series on the General and the ARRL handbook I have the theory pretty well down. The thing I feel I need most is the code speed. I listen to the code session nightly over W1AW and the one thing that infuriates me to no end is the QRM that takes place on the same frequency. Not to completely rule out coincidence, but on 3.520 and 7.020 MHz, shortly before and after each session, is reasonably clear. As soon as the session starts though, it is sheer frustration to try to copy 13 or 15 wpm. So the object of my letter is to remind all hams, members and non-members of the ARRL, that they are not really hurting the League but hurting their fellow hams and would-be hams trying to better themselves in their chosen hobby. Thank you.

Thomas C. Lawrence WN4QLW
1704 Avondale Dr.
Altavista VA 24517

Licenses

Shame on Ravin' Dave (Leaky Lines, Jan. 73) Most of the techs I know got their licenses honestly and I do hope we get some 10-meter privileges. I'd like those privileges to be for CW operation since we techs have virtually no way of in-the-field improvement. As for Conditionals – I agree that the Conditional license is a great mistake. Provisions should be made for those for whom it is impossible to reach a testing station to receive their tests by mail, but I don't believe a ham should be denied the elements he has already passed when he wishes to upgrade his license.

We here in Idaho are fortunate to have two periodical testing stations – Spokane, Washington and Missoula, Montana. But some hams in North Dakota, South Dakota, and Montana are forced to travel great distances (over 300 miles) to take their tests in person. My suggestion is that the FCC take some of the money gained by license-fee increases and set up more twice-annual testing stations. Then the

I think Wayne is trying to do for ham radio what Ralph Nader is trying to do for the nation as a whole. And I feel sure that the majority of the members of our group are of the same mind.

Fr Paul
St. Joseph Hospital
Ottumwa IA 52501

I like the January cover, but must we wait till she makes the centerfold of Playboy to find out her technical statistics?!

Mike K7LYK
116 Stewart St.
Seattle WA 98101

Eat your heart out.

. . .Ken

Repeater Info

I wish to congratulate your magazine on the repeater directory data in the April 1970 issue, no one should be without it.

Don S. Righello
Sec. Treasurer
CCARS

Personnel at this base are very much looking forward to your much needed repeater directory as they go to assignments all over the country from here. See you on 2m.

John W. Patterson WB4HKE/5
President, K5TYP
ABPS (AMATEUR RADIO)
Keesler AFB, Biloxi MS

We appreciate the attention you are giving to those interested in FM.

Ken Adams K4MOC
President, Carolina Repeater Society
Route 2, Box 311
Columbia SC 29203

The Long Run

Here in Reno, they are now doing big things with FM long hauls:

Local 146.94 goes to a remote base locally, which hauls it down to the QTH, and then it goes back up to the remote base and comes out on six meters. On 6 meters, it's passed on to Bishop (a long way off). It's picked up at Bishop and goes on 2 meters to Rogers Mountain, where it goes on

now askew, you've pushed me too far. How about straightening up and flying right?

J. H. Gilbreth
1168 Kenyon Dr.
Ft. Washington PA 19034

Since the news material in 73 is about 90° out of phase with the technical content of the magazine, it seems only reasonable to print it so. We do recognize that many readers have worn a deep rut in their handling of magazines and thus find it difficult to make the change required. For these unfortunate souls we have two possibly helpful suggestions. First they might consider learning to read vertically . . . after all the Chinese and Hebrew writings are this way . . . a little practice is all it takes. If this is too much trouble, perhaps night classes can be organized in the larger colleges to familiarize readers with the best methods of holding a magcinze at 90°. These failing, we may be able to make a pair of 90° prism glasses available with longer term subscriptions. We will, of course, welcome any helpful suggestions from readers.

. . .Wayne

A Profit in the Biz

I am an avid fan and subscriber to your magazine, and may you continue publishing it past 73 years.

I was most disconcerted to learn that the magazine industry in Peterborough is not on a profitable basis.

If I may suggest, I believe the answer may be in the form of additional advertising, but not in the amateur radio field. You hit the point in your last editorial, mentioning Mr. Herter's slippers. While not all of Herter's merchandise would be of interest to all amateurs, most would certainly consider slippers to comfort the feet during long, tedious hours trying to get that new country. I envision: Do you have trouble staying awake throughout the long contest weekend? Falling asleep at 3 a.m.? Drink espresso coffee! It'll keep you awake!

Do you have trouble powering your rigs on field day? A Honda 3 kW generator will power your setup. foregoing suggestions helpful.

Michael R. Hanna K8UUO
6503 Orchard
Parma OH 44129

No, not too helpful, except that now we can stop worrying about Collins ever advertising in 73.

Green on Tonight

I have been reading 73 magazine for over two years and I've really enjoyed your great magazine. You have said many times that each and every ham has a responsibility to spread the word of ham radio to the public.

I think I have the answer to reach as many people as possible. Wayne Green needs to become a guest on Johnny Carson's Tonight TV show and tell the vast number of TV viewers the story of ham radio. Wayne could show some of his QSLs and maybe even have a sked set up so he could work someone on the show.

I think this would be a great way to tell the public of ham radio and make some new friends of the service.

Maybe some of our New York hams could get an invitation for Wayne.

William A. Barbee WA5ZXG
Lula MS 38644

Tell it to Johnny

. . .Wayne

The League and Wayne

The most constructive idea I've heard is that we support Wayne for president of the ARRL. Contrary to what some think, I think the worst thing that could happen is a new League. Look how many problems the American political system has with two parties. In fact, I'm even considering joining the League for the first time since I got my ticket in 1963 just to support Wayne.

I'm very glad to see constructive thinking still exists in amateur radio. A 220 MHz hobby band is a great idea, though I don't see a lot of difference in the idea as proposed, and the Technician; 5 wpm never was much of a code requirement. I am a CW op. Right now all I have is a Ten Tee PM3 in my shack. But get the band in use! Let's stop talking about CB'ers and non-ham hams, and get interested amateurs on that frequency. Who knows, maybe in a

What can a 64-year-old SWL do to help to promote a new hobby channel.

We think it would help to clear up the bootlegging and some TV interference and C B channels.

V. M. Blosser

Write your congressman suggesting immediate passage of RM-1633.

I am in the process of getting my license again after letting it lapse 20 years ago. Things have changed and your magazine helps me "catch-up" as well as it provides interesting articles and projects.

One problem I'm encountering, which might be one for other newcomers as well, is the extensive usage of abbreviations. This may seem ridiculous; however, I have few if any hams to ask such questions of. Perhaps an article in upcoming issues?

Chuck Gerttula
P. O. Box 47
Agate Beach OR 97320

Something for us to think about.

. . .Ken

WWV Via Drake

Here is a bit of information for Drake R-4B receiver owners that might be worth publishing: WWV can be received on the Drake R-4B receiver, without accessory crystals, by placing the controls in the following positions:

Band switch:	3.5 MHz
Xtals:	Any position
Preselector:	Approximately 5½ (tune for peak signal
Main tuning:	0.132 approximately
Other controls:	Normal positions for operating

I believe that this is the 5 MHz WWV signal, due to daytime poor signal propagation. After dark, the signal is excellent.

Louis Hodges W9LMI
Route 1, Box 117
Chester IL 62233

W1AW QRM

As we all know, there are a lot of corrections that should be made in the ARRL. Let me also say that there are some good points, too. One of these is the W1AW code practice. I am a

Conditional class could be done away with and those who feel they are too far to take their tests would have no room for gripes.

Still enjoy 73 as much as ever and hope to see all the fine departments grow. I looked at a copy of QST the other day and found it the same outmoded DX gossip sheet as ever.

Cathy Beare WA7PEE-WA7PNQ
Box 65
Coocolalla ID 83813

Need CW Help

Just got January 73 and it is great. I really like inverted attic antennas, and I am considering the possibilities of a 40m array. Other articles enjoyed are *Amateur Study Guide* and *There is a Santa . . . But.*

Now, down to business. I am 13 and find radio interesting, though I have no ticket. I have the theory down but need HELP with CW. If anyone will help, drop me a line. (By the way I am building the transceiver in the December issue for 40m).

James Walroth
809 Depot St.
Youngwood PA 15697

Angels and Halos

I really liked your January cover of WA1JYV on her VW. Having the beautiful young lady pose with her halo was neat.

William A. Chanis WA5JCK
P.O. Box 259
Alvin TX 77511

A New Start

After reading "A New Start From Washington" (Feb) written by such a good oldtimer I want you to know that I am in full accord.

Consider using our ham call letter plates to help raise money to lobby for the desperately needed changes in our ham rules. Each ham who contributed would have a call letter plate or plates to show he personally was interested in bettering our hobby. If each ham were to sign a statement declaring that his name could be used in petitioning the FCC to legislate for better hamming (this statement could be worked into the order form) this would be to show the people in Washington that we as a group want a better hobby.

450 to W6SLR (Blue Ridge repeater, in California), and then out again on 146.94 . . . and we then wind up talking to Los Angeles and/or Las Vegas.

It's awful, but it works and is great fun . . . till the ragchewers get on the channels and do things. . .

Want me to say that again?

Art Brothers W7NVY
Box 2124
Reno NV 89505

Makes me miss the good old days in the land where things happen.

. . .Ken

Mystery Woman

What's the story behind WA9XYZ?? No "X" calls are issued except for experimental stations from what I am lead to believe. Back in the early 60s there was a W9XYZ listed along with an "XYZ" in all the other call letter areas. The address listed for them was the same address in Illinois.

Now I find a picture of an XYL on news page 3 of the February issue with a similar call and not listed in a new Callbook. Any ideas?

Andrew C. Mueller
2222 Oaklawn Avenue
Waukesha WI 53186

None whatever.

. . .Ken

I had hoped that you were only experimenting with the new logo. I guess I was wrong. You must actually *like* to see 73 printed in that little sqinty-eyed type. I always thought of 73 as a modern, rather than "mod" magazine. You probably like maxi skirts and octagonal eyeglasses as well. My subscription is coming up for renewal – should I? (And I've been with you since 1961.) Please, let's see that big proud "73" like it always has been since the beginning on the cover.

Doug McGarrett WA2SAY
28 Holbrook Road
Centereach, L.I. NY 11720

OK. But you don't realize what kind of war you've started among the staff members, all of whom dig micro-miniskirts.

. . .Ken

What's really different about FM?

Ken Sessions K6MVH

If you're an active ham who uses sideband or AM, you're probably wondering why everyone is making such a fuss over all this 2 meter FM activity. Well, it does have a few things going for it. And it might even win *you* over. Take the ordinary receiver noise you're used to hearing, for example . . . it's one of the most undesirable characteristics of AM radio, but it's practically nonexistent with FM. The reason? Squelch! Highly efficient squelch circuits are standard equipment on FM receivers. These circuits keep *all* audio from the speaker until an *intelligible* signal appears on the frequency.

Then there's the matter of sensitivity: FM receivers are generally more sensitive than their AM equivalents. A threshold sensitivity figure of 0.2 μV is not at all uncommon. And in most FM receivers a signal of no more than one-half of a microvolt will give copy that couldn't be classed as anything less than S9! This compares to something on the order of 50 microvolts to accomplish the same end in an AM receiver. Pretty impressive so far, isn't it?

The most noticeable differences between AM and FM VHF, though, are the operational peculiarities. FM operation is unique among amateur modes in that it employs the "channel" concept. Transmitters and receivers are crystal-controlled to operate on any one of several discrete frequencies. No one ever "tunes in" another station or zero-beats a carrier. Since the FM channels are all standardized on the 2-meter band. new operators only need to learn what channels are the most active in their area. After an initial expenditure for a few crystals, "radioing" will require no more attention. From here on in, it's simply a matter of turning on the rig and listening to whatever signals come on. There's never a need to tune the transmitter, because once it's tuned up on a frequency, it will stay tuned up. And the channels are usually close enough to one another to preclude the necessity for retuning after even drastic channel changes.

This kind of operation is admittedly a little hard to get used to – especially for the devoted VHF AM man, who tweaks his transmitter every time he goes on the air, and who sits patiently running his receiver frequency control back and forth across the spot where he's just called CQ. Most of us who are new to FM feel a need to *do something* – and with FM, there's nothing *to* do. It's a bit maddening at first – but the whole concept gets appealing before long.

Domestic Considerations

I think FM has done more to bring harmony into hams' families than any other single element. Look at it objectively. Women don't like the noise of radio as a rule (if you can safely generalize about women). And they don't like competition. Until FM came along, there wasn't much

we could do about the noise. AM squelches have never been effective because they keep out signals when they're set tight enough to keep out noise. To wives, the noise is distracting and bothersome. With FM, there is dead silence unless someone is actually using the frequency.

If you don't think regular hamming is competition for the wife, consider your routine operating habits. You get in the car and turn on the rig. (Your wife is sitting in the passsenger seat.) You lean over and tune up the transmitter – first the oscillator, then the multiplier stages, then the final – peak, dip, peak, dip.

Are you ready to start being a husband? Not quite. Now you're ready to make a contact. You've got a clear spot, so you call your CQ – and another couple of minutes are shot. After the CQ, you've got to tune around to see if there's someone who might have heard you. If nobody's right near the frequency, you figure maybe they're rockbound somewhere at the other end of the band, so you go hunting. And your wife just sits there like a bump on a log, maybe wishing you'd married the radio and she'd married that nice fellow who got to be president of the local bank.

Contrast all that with the way FM units are set up. You turn on the key to the car and the rig comes on – on channel, tuned up, ready to go. If you want to talk with someone, you say a word or two into the mike (no CQs, though, they're completely unnecessary). That's it. Now, if anyone is listening to the channel, he'll hear you. And if he feels like talking to you, he'll let you know.

That's really how wives get interested in radio, too. They see how simple it is to operate an FM unit, and suddenly they become interested. Many wives really kind of dig the idea of communicating, but they can't stomach all the peripheral tuning, loading, dipping, tuning jazz that accompanies the more conventional types of operation. That's why wives are frequently heard on FM, though rarely on SBB or AM.

Frequencies of Operation

Today there are 63 standard FM channels on 2 meters. Little more than a year ago there were but 31. The 31 channels were spaced at 60 kHz intervals, starting from 146.04 and extending to 147.84 MHz. As more and more people came into FM, the requirement for additional frequencies became apparent – particularly for additional channels reasonably close in frequency to the most popular of the older channels. The more ancient pieces of surplus FM equipment were set up for wideband operation (30 kHz bandwidth), so there wasn't much anyone could do about increasing the concentration of channels. Not then.

But finally, more modern equipment began to find its way into the ham market – equipment designed to operate within a bandwidth of not much more than 10 kHz. And specially designed amateur FM gear made the scene. So, as amateurs began to acquire this later vintage gear, they also began to "split" their channel spacing. Now, rather than establishing wideband channels at 60 kHz intervals, the FM'ers have established narrowband channels at alternate 30 kHz frequencies, as shown in Table I.

Even though the early 31 channels are earmarked for wideband operation, it is a fact that many users have abandoned their insistence for that mode. Many –,indeed most – of the active FM groups have settled on a compromise standard that consumes a bandwidth of around 20 kHz. This compromise allows use of the older wideband gear as well as the newer narrowband units within a single compatible communications system.

Not all the FM channels are active yet, of course, but the number is growing all the time. Those channels that lie between 146.31 and 147.0 are the most popular, with the lower channels being used chiefly for repeater inputs and the upper ones for repeater transmitting frequencies. Across the country, 146.94 MHz is the single most popular channel, and was once referred to as the national "calling frequency." The prominence of repeaters has pretty well eliminated the need for a calling channel per se, because where a repeater is there is generally a monitor on a continuous basis. Still, 146.94 is often used for point-to-

point communications as well as repeater operation. And in areas where there are no repeaters, you're still likely to find a great deal of activity on 146.94.

The second "big" channel is 146.76 MHz. Where areas were very active on 146.94 on a "simplex" basis before the advent of the 2 meter repeater, the repeater groups have had to select an alternate. (Most have found that is is foolhardy to install a repeater whose output frequency is the same as that used by all the active hams in the area.) "Seven-six," as it is called, was a logical second choice because of its popularity as a simplex channel over various parts of the U.S. Today, a number of the heavily congested metropolitan areas (other than California) use seven-six as the prime repeater output. Chicago, many cities in Ohio, Washington (state), and the lower eastern seaboard are examples of areas where seven-six reigns supreme as a repeater output.

As stated, repeaters today are exceedingly popular. It is the exception where a fairly good-sized metropolis does not have at least one 2-meter repeater in operation. If you're thinking about buying an FM transceiver, You'd do well to check into the local situation. See if there's a repeater in your area (or two, or three) – then, when you order your rig, make sure you get enough crystals to make full use of all the repeaters within your range. (Be sure to check with the local groups before you do too much operating, though. Some repeaters are actually set up as clubs, and you must become a dues-paying member before you'll be welcomed on a regular basis.)

Deviation/Modulation

One word you'll hear a lot when you're operating FM is "deviation." This is roughly comparable with "modulation level" of AM; deviation, however, is a function of frequency variation (and, of course, bandwidth) rather than audio amplitude, even though they may seem the same from the point of view of the listener.

In general, the standard deviation level for amateurs is on the order of ±10 kHz (the compromise mentioned earlier between wideband and narrowband). If your transmitter is set up for anything much greater than this figure, your signal may be so broad that other stations cannot even detect your signal at all. Overdeviation looks like noise to a good receiver, and its squelch will lock you out. On the other hand, if your deviation level is set too low, your audio may be deficient in terms of apparent amplitude. And if your signal is weak into someone's receiver, his noise may be a lot louder than you are. At 10 kHz your signal should work out fairly well into a wideband receiver, and you should have no trouble getting into narrowband units if you don't hit the mike too hard. In commercial service, special deviation meters are used to make sure all the units within a communiciations system are uniform. But with amateur repeaters, things aren't that critical; you can ordinarily set it satisfactorily by adjusting the level while getting reports from one of the other fellows using the system.

Tones

You'll hear quite a lot about "tones" on FM (if you haven't been hearing it already). Why would amateurs be concerned about something so unlikely? In a word, the answer is "control." Repeaters often require simple switching sequences – perhaps to turn them on or off under certain circumstances, to change antennas, or to shift to an alternate frequency. As you probably already know, though, there is usually nobody manning the repeater physically; so the control switching must be accomplished via radio signals. If you could send ordinary dc signals over the air, the switching functions could be simplified, but of course that is quite impossible. The only practicable approach is to convert the control voltage to a type of signal that *can* be transmitted via rf. Here, tone signals qualify nicely.

An audio tone of a specific frequency can be detected from a large array of audio signals. If such a detector circuit is set up so as to key a relay whenever that particular tone signal is present, the remote switching problems are solved.

In commercial two-way service, repeaters and remote stations have been

using tone signals for years to control functions, and the result has been the standardization of specific tone frequencies. These, like FM channels themselves, appear at fixed intervals across the audio spectrum. Figure 1 shows the allocation of control frequencies currently in use by amateurs.

Notice that a frequency "block" at the lower end of the usable audio spectrum is set aside for control – this is in addition to the "channelized" control frequencies on the upper end.

Another block appears in the 1.5–1.65 kHz range. This portion of the spectrum is typically used for control of uncritical functions. This particular block is used because of the simplicity by which a control signal can be initiated. For example, when you pucker up and whistle, the signal you generate will fall in this "uncritical" block. And here is the spectrum used by those so-called "whistle-on" repeaters.

The control frequencies above the whistle-on block are set up at intervals of precisely 150 Hz. Officially, the "channels" are 1650, 1800, 1950, 2100, 2250, 2400, 2550, 2700, and 2850. These signal frequencies are far enough above the ordinary "voice" range that it is difficult to simulate the signals by whistling. So amateurs use simple electronic tone generators.

Many repeaters require the presence of a short "tone burst" as a prerequisite to causing the repeater to operate. The concept, called "tone burst entry," is very common where several repeaters overlap in coverage. Suppose, for instance, that you live in an area served by several repeaters, all of which use 146.34 MHz as their input frequency. It would be annoying for other users if you triggered all repeaters each time you transmitted. To obviate such a possibility, repeater groups will select certain tone frequencies for control. Thus, you might transmit a short tone of, say, 1950 Hz to trigger one of the repeaters, and another, of perhaps 2100 Hz for another. The whole business usually works out pretty well.

The block of low frequencies is used for the most critical applications, and normally where *continuous* control signals are required (as opposed to *tone bursts*). It is the rare repeater that uses these low frequencies (called *continuous tone carrier squelch system*) for control, however; so there is no need to go into any great detail about the

Table I. 2m FM Channel Allocations

NARROW	WIDE	NARROW	WIDE
146.01	146.04	146.97	147.0
146.07	146.10	147.03	147.06
146.13	146.16	147.09	147.12
146.19	146.22	147.15	147.18
146.25	146.28	147.21	147.24
146.31	146.34	147.27	147.30
146.37	146.40	147.33	147.36
146.43	146.46	147.39	147.42
146.49	146.52	147.45	147.48
146.55	146.58	147.51	147.54
146.61	146.64	147.57	147.60
146.67	146.70	147.63	147.66
146.73	146.76	147.69	147.72
146.79	146.82	147.75	147.78
146.85	146.88	147.81	147.84
146.91	146.94	147.87	

Note: Though there are no known wideband repeaters on channels designated as narrowband, it is not uncommon to operate narrowband repeaters on channels designated as wideband.

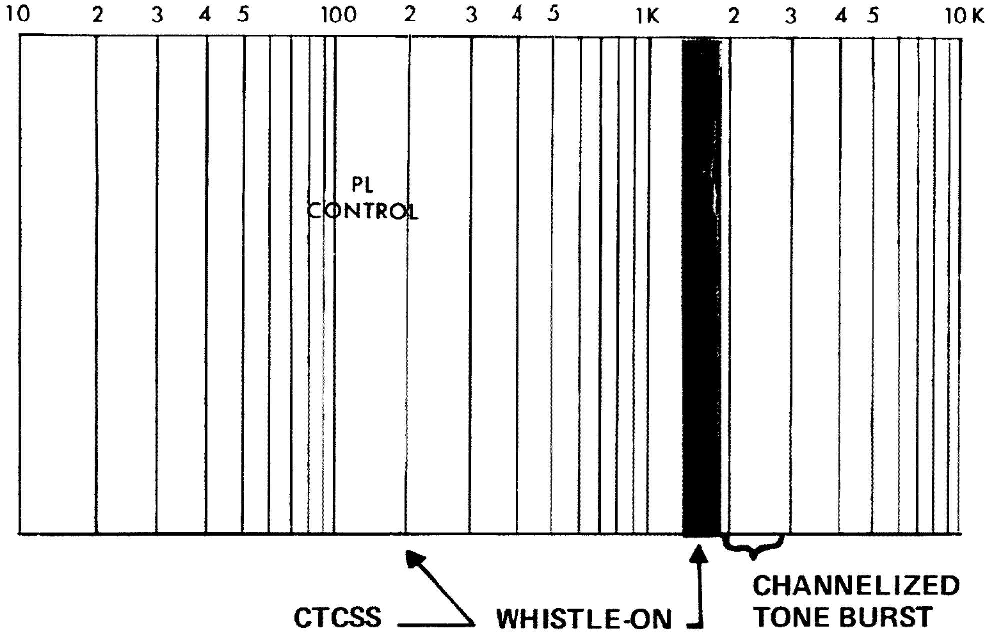


Fig. 1. Audio spectrun showing tone allocations.

applications and tone generation techniques.

What's It Like?

Do a little snooping. One of the most surprising characteristics you'll notice is the overall absence of those old cliches you hear so much on AM. Such expressions as "one-eyed monster," "snore shelf," "big switch," "bucket of bolts," "down the old log sheet," and "handle" have been in most cases replaced with their generic terms. It may seem hard to tear yourself away from those old habits, but you might even approve once you get the hang of it. Using generic terms makes your contact seem more like a real person, and not so much like a machine. One characteristic you're sure to notice is short transmission. When someone has something to say, he'll transmit briefly and say it, then drop his carrier. The FM'er has learned that long transmissions are about as effective as no transmission at all. Here's why: Heterodynes on FM are rare – so there is usually no QRM. When two stations transmit simultaneously, the stronger will "capture" the weaker in the listeners' receivers. So, when you talk, no one else can use the channel unless they clobber you. Also, most repeaters are set up with limit timers: If any one transmission exceeds a specific limit (between 1-1/5 and 3 minutes, usually), the repeater automatically shuts down and stays off the air until the longwinded individual himself goes off the air. And all the while it's off, the other users are fuming. Nobody can use the system as long as the diehard blowhard continues with his unwanted and unheard dissertation. To an AM'er accustomed to long, drawn-out transmissions, this may seem unfair. But most FM'ers feel there is nothing that requires more than a few minutes of air time to convey. The FM'ers can't QSY a few kilohertz to avoid the longwinded ham. They all realize that if they didn't talk over him, no one could use the channel. By all means talk. But save a few words for the next transmission. The repeater will still be there – and so will your listeners if you play it cool!.

The Last Word

I always like to admonish prospective new converts to FM. This mode is different – it's kind of like certain kinds of communicable diseases in that it will not only affect you but very likely your friends and family as well. Once you get going on FM, it's awfully hard to quit. For FM adds something to ham radio – it complements any station set up for any kind of activity. Just see for yourself.

...K6MVH■

aftermath: NOISE BLANKER that works

Robert Grenell, W8RHR
3926 Beech Street
Cincinnati OH 45227

Since my article, "Noise Blanker That Works," appeared in the April, 1970 issue of 73, I've been buried in requests for help, advice and information. In every case, I've tried to get answers off in not less than a couple of days, but the flood continues. Yes, there were a couple of mistakes, principally the omission of point A in the schematic. And, I'm afraid I was guilty of a couple of assumptions when I wrote the article.

First of all, I have revised the schematic, and it does include point A. However, I have substituted a 10 mH rf choke for the i-f transformer which was previously shown. Since this is a noise amplification circuit, the fact that it's broadbanded with the rf choke is not a problem. The choke has advantages in size, and eliminates one adjustment. . .and it works just as well as the tuned circuit. If you prefer to use an i-f transformer, no problem: Just make sure it's the same frequency as the i-f of your receiver or transceiver. I received an amazing number of inquiries about what frequency the i-f transformer should be!

Another set of inquiries was caused by my assumption that most hams would be using the blanker in a receiver. To my chagrin, it appears that about 4 out of 5 who wrote me intend to use it in a transceiver. To use the blanker in a transceiver, certain special considerations must be observed.

First, most transceivers (indeed, most modern receivers) do not have an i-f stage ahead of the selective circuitry. For maximum benefit from any blanker, it should be installed ahead of the filter. This necessitates using a cathode follower between the mixer and the filter, around which the blanker can operate. In the schematic, such a stage is shown as it would be installed in a typical transceiver.

The most important consideration in transceiver installations is brought about by the fact that the blanker is applied to the filter input, where both transmitted and received signals are present. If the transmitted sideband signal at this point is too strong, the blanker diode will clip, causing severe distortion, and possible

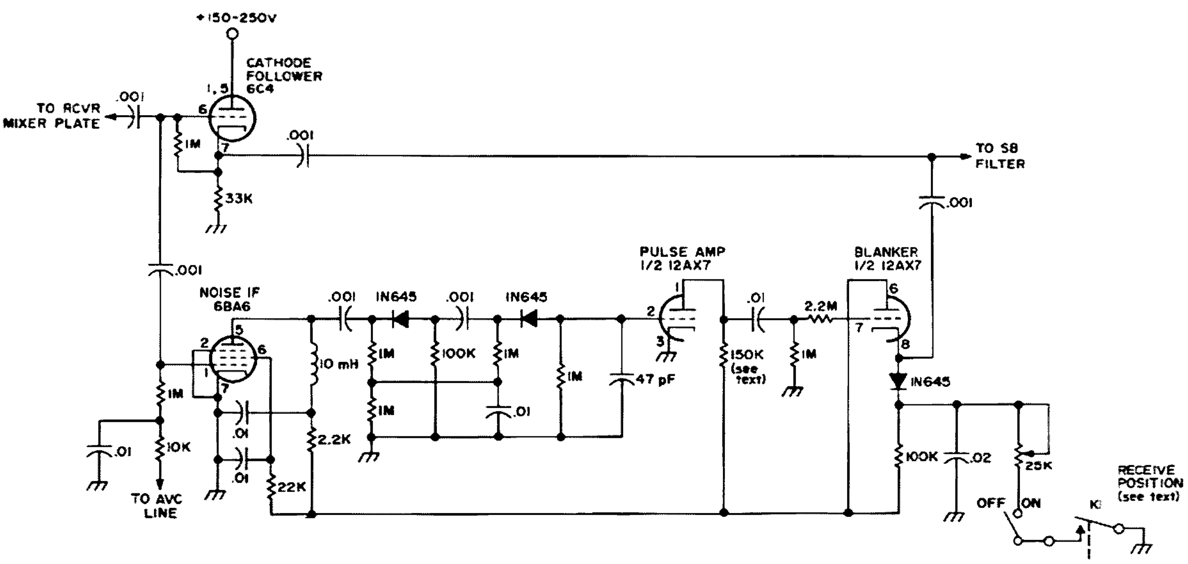


Fig. 1. Revised schematic of the noise blanker that really works!

splatter. Therefore, the blanker *must be deactivated* in the transmit mode. The only sure way to accomplish this is to use an open section of your TR relay to break the connection between the blanker on/off switch and ground when transmitting. If necessary, install an extra relay to do it. The importance of this point cannot be overemphasized. Failure to do this will not only make you sound like Donald Duck with a sinus infection and reduce your popularity with your fellow hams, but it could net you a pink ticket!

The input and output leads to the blanker must be shielded and short! At higher intermediate frequencies, excessive cable capacity can pull the tuned circuits or filter tuning capacitors too far off to peak up. The only solution is to use short leads, or compute the capacity of your cable and reduce the capacity in the tuned circuits by the same amount.

Do not overlook the connection to the avc line. Without avc, the blanker will clip excessively on strong signals.

In some cases, it is possible that more gain is needed in the first triode stage to get dependable blanking action. If this is the case, you can increase the value of the plate load resistor as far as necessary. You can even make it a kind of "starved circuit" amplifier, since we're dealing with dc pulses here, and frequency response is not important.

A large number of inquiries were received from hams who wanted to know what signal-induced voltages at various points in the blanker should be. These voltages depend greatly on the gain of the rf stage, the efficiency of the mixer, and the effectiveness of the avc action, not to mention the signal and noise levels encountered – too many variables to consider. Also, it is impossible to measure many of these voltages, since they are instantaneous noise peaks. Only a scope could serve the purpose.

When the blanker is activated, there will be a slight (1 to 2 dB) decrease in signal levels – just enough to notice. But noise will decrease dramatically. On extremely strong signals, particularly AM, there may be some clipping distortion from the diode when the blanker is activated. There is no cure for this, but then you don't need the blanker for strong signals, anyway, so turn it off.

Installed as demonstrated in the revised schematic, the blanker is truly universal and foolproof. Please don't hesitate to contact me if you experience difficulties in getting it going. I'm working on a solid-state version using the same basic principles. Watch for it. It should be better, offering faster blanking action. 73 readers will be the first to hear about it.

. . . W8RHR ■

Donald L. Milbury W6YAN
Box 463
West Covina CA 91790

Technological Locusts That Plague The Age Of Repeaters

The heavy loading of active frequency channels on the amateur radio spectrum around metropolitan areas has produced increasing problems of interference – especially that ol' debbil called intermod. The combinations of frequencies that can mix together and produce intermodulation interference on a given frequency are practically countless. But the product chart of Table I does list the intermod products of the more commonly used 2 meter FM channels. By comparing this list of possible interfering frequencies against the frequencies in use in your own area, you should be able to narrow the search for the specific interfering frequencies. The products tabulated on this chart are derived from the equation 2A-B or 2B-A, where A and B are the mixing frequencies. Most intermod interference problems will result from this third order intermod product.

Other Causes of System Degradation

Transmitter noise. Transmitter noise interference results from transmitter broadband noise radiation which is received on frequency and degrades or masks the desired signal. In general, transmitter noise is the result of noise components generated in the lower frequency multiplier stages being amplified through the final power amplifier and passed on to the antenna through the relatively broad selectivity of the amplifier output circuits. Transmitter noise generally is the dominant interference factor (over desensitization) at frequency separations up to 1 MHz.

In the present state of the art, it is even higher for solid-state devices than for circuits built around vacuum-tube designs.

Receiver Desensitization. Receiver desensitization is caused by strong, off-frequency signals that enter the front end of the receiver, driving it into saturation and thereby desensitizing the front end to the desired on-frequency signal.

The sorry fact is, any vacuum tube amplifier subjected to excessive grid drive voltages will draw grid current and undergo a shift in operating point. Depending on the circuit used, this grid current will produce a self-bias grid voltage. When a high bias voltage exists, it takes a correspondingly larger signal voltage to overcome the bias voltage before the tube can act as an amplifier. That's life.

Since a strong interfering signal cannot be completely eliminated from the rf stages, this signal can produce grid bias voltages which require stronger-than-

normal signals to overcome the bias. This reduces the effective receiver sensitivity. The effect is principally noted in the second mixer. When the desensitization threshold is exceeded by a strong signal, the gain in the second mixer is reduced because of the signal amplification prior to the second mixer. As the level of the undesired signal becomes extreme, the first mixer is also affected.

Back to Intermod. Intermodulation is defined as the production, in a nonlinear transducer element, of frequencies corresponding to the sums and differences of the fundamentals and harmonics of two or more frequencies which are transmitted through the transducer. When two or more of these frequencies are "mixed," an infinite number of new frequencies are generated. Only a few, however, are located in that portion of the spectrum near the fundamental mixing frequencies.

The general equation for the intermodulation products is:

$$F_{IM} = NB_1 \pm N_2 (B-A)$$

Where A and B are the two mixing frequencies.

By substituting values of N_1 and N_2 of the equation, one can see that an infinite number of odd- and even-order intermod products are generated when two frequencies are mixed. However, the even-order intermod products occur at frequencies well out of range of the problem area while the odd-order intermod products have frequencies which are close to the mixing frequencies. Figure 1 shows the spectrum of these products in relationship to mixing frequencies A and B. These are the frequencies which are most apt to cause interference problems.

The above discussion includes the intermod products of only two frequencies. A situation could exist where three or more frequencies mix to produce a product which could interfere with a system.

Diagnosis of Interference Problem

If one is faced with the problem of intermodulation interference, it would be extremely helpful to know the frequency of at least one of the signals being mixed. Often it can be recognized immediately

Table I. Intermod Product Chart

	146.40	146.43	146.46	146.69	146.52	146.55	146.58	146.61	146.64	146.67	146.70	146.73
145.22	146.04	146.01	145.98	145.95	145.92	145.89	145.86	145.83	145.80	145.77	145.74	145.71
146.25	146.10	146.07	146.04	146.01	145.98	145.95	145.92	145.89	145.86	145.83	145.80	145.77
146.28	146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95	145.92	145.80	145.86	145.83
146.31	146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95	145.92	145.89
146.34	146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95
146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01
146.40	146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07
146.43	146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13
146.46	146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19
146.49	146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25
146.52	146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31
146.55	146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37
146.58	146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43
146.61	146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49
146.64	146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55
146.67	146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61
146.70	147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67
146.73	147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73
146.76	147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79
146.79	147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85
146.82	147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91
146.85	147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97
146.88	147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03
146.91	147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09
146.94	147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15
146.97	147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21
147.00	147.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27
147.03	147.66	147.63	146.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33
147.06	147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39
147.09	147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51	147.48	147.45
147.12	147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51
147.15	147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57
147.18	147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63
147.21	148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69
147.24	148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75
147.27	148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81
147.30	148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87
147.33	148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93
147.36	148.32	148.29	148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99
147.39	148.38	148.35	148.32	148.29	148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05
147.42			148.38	148.35	148.32	148.29	148.26	148.23	148.20	148.17	148.14	148.11
147.45					148.38	148.35	148.32	148.29	148.26	148.23	148.20	138.17
147.48							148.38	148.35	148.32	148.29	148.26	138.23
147.51									148.38	148.35	148.32	148.29
147.54											148.38	148.35
147.57												

where the interfering signal is intelligible. Also it is likely that one of the interfering transmitters is located geographically close to the receiver. If, on the other hand, neither frequency is known, the problem gets more complex. In a large metropolitan area there could be many possible combinations of frequency channels which could be mixing and producing interference.

Once the interfering frequency is known, the source of the mixing must be found. The intermod product is produced in a nonlinear element which could be in the power amplifier of a transmitter or in the front end stages of a receiver. In some cases, the mixing can occur at some point outside the transmitter or receiver, such as a poor antenna-to-tower connection, or even a rusty drain pipe.

Using the Intermod Product Chart. The channels involved are listed at the left side of the chart and again at the top of the chart. By moving down a column headed by a frequency at the top and moving across a row headed by a frequency at the left, you can find the intermod product of these two frequencies at the intersection of the column and the row (as you find the distance between cities on a road map mileage chart). The most convenient starting point on the chart will be found on the page where your operating frequency is listed at the top and also on the left. At the intersection of this row and column you will also find your operating frequency. From this point on the chart you can begin listing the possible interfering frequencies. The intermod product at your operating frequency will appear periodically on the chart to the left and right of the starting point. A pattern is established by moving up one row and to the left two columns, and by moving to the right two columns and down one row. The intermod product appears both to the left and right of the starting point for several pages. Wherever this product appears on the chart, it will occur at the intersection of the column and row headed by the possible interfering frequencies.

146.76	146.790	146.82	146.85	146.88	146.91	146.94	146.97	147.00	147.03	147.06	147.09	147.12
145.68	145.65											
145.74	145.71	145.68	145.65									
145.80	145.77	145.74	145.71	145.68	145.65							
145.86	145.83	145.80	145.77	145.74	145.71	145.68	145.65					
145.92	145.89	145.86	145.83	145.80	145.77	145.74	145.71	145.68	145.65			
145.08	145.95	145.92	145.89	145.86	145.83	145.80	145.77	145.74	145.71	145.680	145.65	
146.04	146.01	145.08	145.95	145.92	145.89	145.86	145.83	145.80	145.77	145.74	145.71	145.68
146.10	147.07	146.04	146.01	145.98	145.95	145.92	145.89	145.86	145.83	145.80	145.77	145.74
146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95	145.92	145.89	145.86	145.83	145.80
146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95	145.92	145.89	145.86
146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95	145.92
146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01	145.98
146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07	146.04
146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13	146.10
146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16
146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25	146.22
146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31	146.28
146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37	146.34
146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43	146.40
146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49	146.46
146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55	146.52
146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61	146.58
147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67	146.64
147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73	146.70
147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79	146.76
147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85	146.82
147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91	146.88
147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97	146.94
147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03	147.00
147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09	147.06
147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15	147.12
147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21	147.18
147.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27	147.24
147.66	147.63	147.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33	147.30
147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39	147.36
147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51	147.48	147.45	147.42
147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51	147.48
147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57	147.54
147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63	147.60
148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69	147.66
148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75	147.72
148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81	147.78
148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87	147.84
148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93	147.90
148.32	148.29	148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99	147.96
148.38	148.35	148.32	148.29	148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05	148.02

Example 1: Neither Frequency is Known. If your receiver frequency is 146.94 MHz refer to the spot on the chart where 146.94 MHz occurs at the top and the left side of the page. Moving to the side and up (and down) as indicated above, you'll find the frequency occurs at the intersection of the column and row headed by 146.88 MHz and 146.91 MHz, both of which are possible interfering frequencies. By continuing on in this manner both to the left and right of starting point, you will find many combinations of channels which may be interfering with you. A knowledge of the channels in your area will probably narrow the possibilities to only a few channels.

Example 2. One Frequency is Known. If one of the interfering frequencies is known, the other frequency can easily be found. For example, assume that intermod interference is being experienced in a receiver operating on 146.94 MHz. One of the interfering or mixing frequencies is intelligible, and known to be operating at, say, 146.82 MHz. To find the other mixing frequency, follow a two-step procedure. First, locate the 146.94 MHz product on the chart under the 146.82 MHz column and note that it intersects the row corresponding to 146.88 MHz. This frequency, 146.88 MHz, can be the unknown frequency (2A-B where A is 146.88 and B is 146.82). Next locate the 146.94 MHz product in the chart where it appears on the row opposite 146.82 MHz (left columns) and note it is under the column headed by 146.70 MHz. This frequency, 146.70 MIIz, can also be the unknown frequency (2A-B where A is 146.82 MHz and B is 146.70 MHz). Of course there are other equations that will produce intermodulation products, and intermodulation is not the only form of interference. The intermodulation product chart will be of assistance to you in showing a few of the combinations that can affect your system and through your owr refinement and application of the chart, it can be of benefit to you.

W6YAN■

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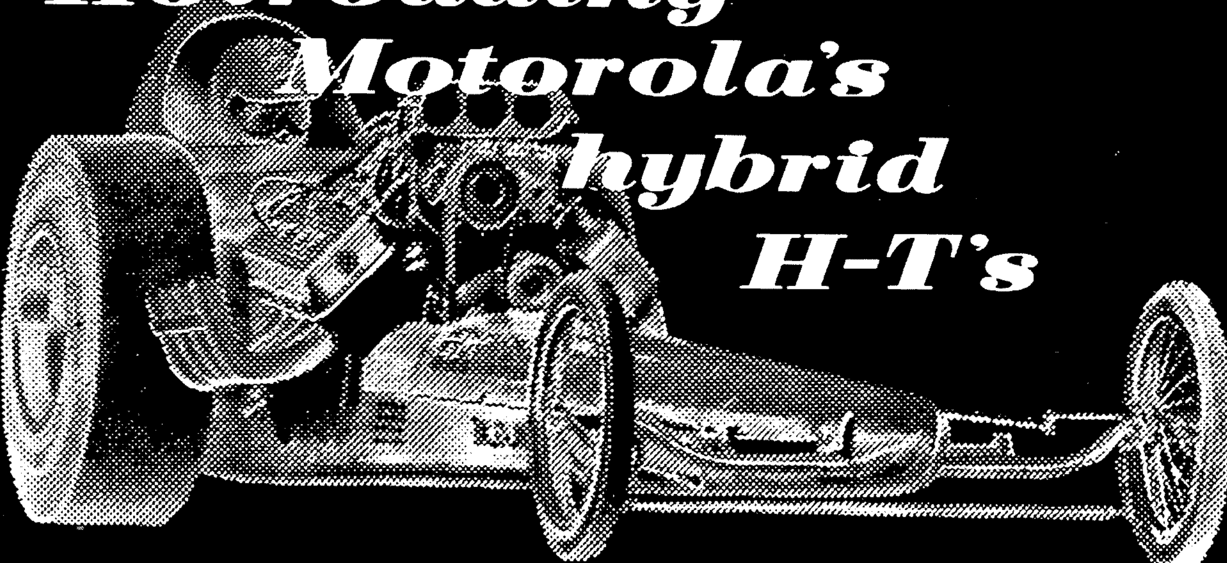
Hotrodding Motorola's hybrid H-T's



The old H23 Handie-Talkie was a hybrid job: The receiver was a mishmash of vacuum tubes and transistors. This article tells how to eliminate the tubes in these early versions and end up with an all-transistor receiver capable of easily outperforming the later stock units.

Motorola introduced the first commercially available transistorized portable FM transceivers some time around 1956. These beautiful little units are now widely available to amateurs, but they come in a bewildering assortment of type numbers. For example, a P33-4 is a single-frequency transceiver for the 144 – 174 MHz region with 7 watts output, microphone, speaker, and rechargeable nickel – cadmium battery; an H23AAC-310AH is a high-band split-channel one-watt unit with handset and extra-duty dry battery.

The year 1956 was such a short time ago that it is sometimes startling to remember that available transistors at that time would not oscillate above about 1 MHz – and anything above that was vacuum tube country. So it was that the local oscillator and the two first i-f's of the Motorola HT receivers used vacuum tubes. Later units were completely transistorized, and a conversion kit is still available from Motorola (NED6004A, $74.00) which updates the early receivers to the fully transistorized configuration. If your unit has the late-model receiver, go immediately to some other article, because the remainder of this one will just make you wish you hadn't splurged on the nonhybridized vintage.

Using inexpensive N-channel field-effect transistors, the early receivers can be readily converted to fully solid-state operation, and these modified receivers will perform rings around the newer units (which use bipolar transistors rather than the hotter FET's). The necessary modifications will cost about $7, and the work can be finished in little more than an hour.

The FET cascode shown in Fig. 1 is generally useful as a pentode vacuum tube replacement. The transistors specified are readily available either locally or from the larger mail-order supply outlets. Other N-channel FET's, such as 2N3823 and those of the Motorola MPF series, will work equally well. In this application, the supply potential of 50 volts is just right as the two FET's are in series for dc and each gets about 27 volts from drain to source. Resis-

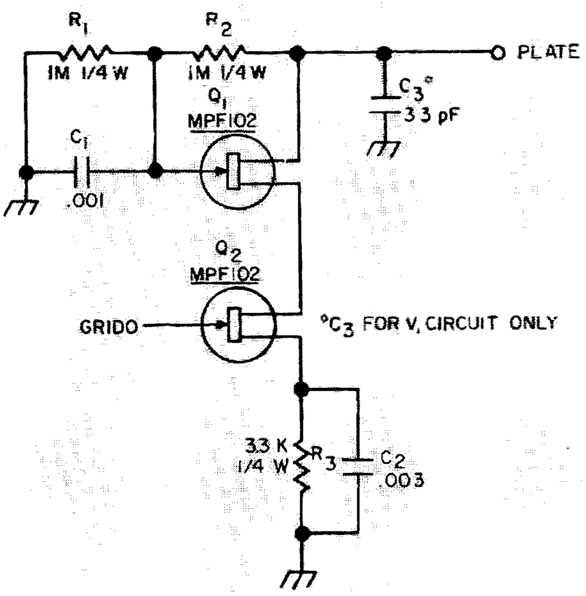


Fig. 1. FET cascode arrangement replaces each pentode i-f amplifier in the H23 hybrid receiver. Note that C_3 is required for the first i-f ampl-fier, though it is not used in the second.

tor R_3 determines the current drawn by the series transistor pair. The current in milliamperes is approximately $2000/R_3$. More than adequate gain is obtained at a current of 600 microamperes, and with the higher gains obtained at higher currents, stability problems can arise.

The output capacitance of this circuit is negligible, so that C_3 is required to correctly tune the output of the V_1 tube replacement. There is sufficient capacity in the output circuit of the second stage (V_2) so that a C_3 equivalent is not required.

Vacuum tube V_3 is triode-connected, so a single FET is used. Capacitors C_4 and C_5 return the crystal operating frequency to that of the original tube circuit. Resistor R_5 drops the 60-volt B+ to a level that is safe for the FET.

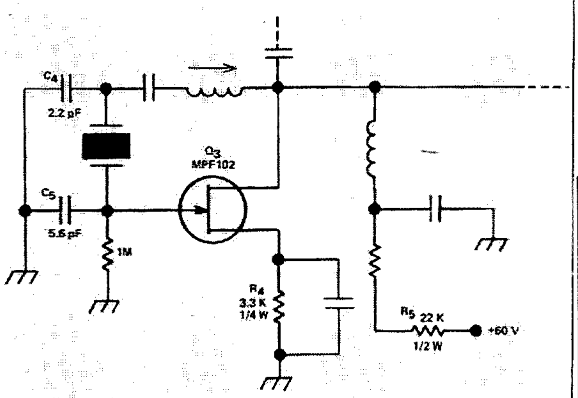


Fig. 2. FET replaces vacuum tube in the H23 oscillator to complete the transistorization operation. Components not labeled in the sketch are those components that are already part of the existing oscillator circuit.

As a last touch, replace the first crystal-mixer diode CR_1 (it will be a 1N72 or a 1N147A) with an HP 5082-2800 *hot carrier* diode. This will only cost a buck, and the expense is worthwhile. My own wide-band H23AAM measures better than 0.4 microvolt sensitivity at 20 dB of quieting, and adjacent-channel problems due to cross modulation have disappeared.

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stability without crystals

a new concept in "crystal" control

The government's way of solving problems is to offer long-range legislation in the form of technological targets to be aimed at by an industry. For air pollution, the federal government set an orderly pattern of increasingly rigid specifications with regard to auto exhaust emissions; and the auto industry must continue to reduce the polluting gases from their products in a continuing series of year-to-year improvements. The only alternative for the industry is to give up the manufacture of internal combustion engines.

The FCC has taken the same course with commercial radio. The problem is the perennial "spectrum squeeze," whereby more users demand more frequencies for more purposes than ever before. One of the approaches was the "splitting" of commercial channels to get twice as many users in a given band. This was accomplished by cutting the maximum bandwidth of user stations by two thirds, spacing channels at half their original distance, and tightening up the frequency tolerances of operating stations. The next step is the further tightening of operating frequency tolerances.

The future calls for frequency adherence to such a degree that ordinary crystal oscillators can no longer provide the stability required for legal operation; for this reason, several firms are busily engaged in projects to either improve the stability of crystal oscillators or replace the crystal altogether. In the immediate future, FCC requirements call for a frequency stability of 99.99975% for base stations (allowing only a maximum frequency error of 0.00025%). For mobiles, with stability problems that will be compounded by changing battery voltages and temperature extremes, the allowable error will be 0.0005%. It is hardly necessary to say that many – indeed, most – commercial two-way radios are not capable of meeting this new tolerance requirement without extensive modification or outright replacement.

Of all the approaches being considered by the various manufacturers, the one that appears the most promising is Sentry Manufacturing Company's MODCOM idea. The MODCOM is a very highly stable crystal-less oscillator built into a conventional crystal oven container. Its most interesting characteristic is the fact that it plugs directly into the crystal socket of existing radio units, and achieves the stability required by the FCC without necessitating any actual modification.

When the Sentry people sent out advance literature describing the plug-in MODCOM units, 73 was on the mailing list. A quick call to the manufacturer was all it took to get 73 lined up with an evaluation model, set up for operation in a 450 MHz GE Progress Line receiver.

In outward appearance, the unit looked for all the world like an ordinary crystal oven – though slightly taller. But there's where the resemblance ended.

The unit was presented to a couple of local amateurs who operate a remote transmitter on a cold, cold New Hampshire mountaintop. The two were Bob (W1JJO) and Dick (W1KGZ), who would test the unit under the adverse conditions of New England's uncomfortable winter environment. They also agreed to make stability measurements at elevated temperatures, which they simulated by applying heat inside the mountaintop building for long periods.

The results of these extensive tests made a very short story: no drift. Perhaps the MODCOM performed *too* satisfactorily, for the 450 MHz "test" unit is still being used at the remote site (the WA1KFV repeater). According to Dick, ambient temperatures in excess of 120° have failed to shift the compensated oscillator element. And discriminator readings show that daily drops to –20° (below zero) are incapable of causing noticeable frequency drift.

According to Sentry representatives, the MODCOM offers a number of corollary advantages by virtue of its direct "plug-in" feature. For example, in addition to bringing the radio within the new restrictive FCC guidelines, the module will eliminate such common problems as sticking oven contacts, contact and thermal noise, and long warmup time. The units are fully solid-state, and use the oven voltage to power the internal micro circuitry.

Another advantage is power consumption – or lack of it. By replacing a snap-action oven with Sentry's MODCOM oscillator module, actual power consumption in the oven circuit is cut by a factor of 25 to 1.

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SWITCHING REMOTE LINEARS

The Tranx Circuit (73, April '66, page 76) for switching the plate supply of a linear amplifier was exactly what I was looking for, having just built up a 25W mobile linear to follow a Johnson Messenger CB rig when used on 10 meters. The Tranx circuit, in case you missed it, is a very small device consisting of a diode (to rectify a little rf picked up from the exciter), two transistors, and a relay. The realy then turns the amplifier off and on as the exciter is keyed.

The only change I had to make in adapting it to 10 meters (the originator of the circuit used it on 2 meters) was in the method of picking up the rf voltage feeding the diode. I simply wrapped four turns of 24 AWG insulated wire around the lead from the input SO239 to the amplifier grid, and ran the end of it through a 1K resistor to ground to provide a dc return for the diode.

But since my linear was to be mounted in the automobile trunk, this still left me with the small problem of finding a neat and easy way to disconnect the 12V filament and power input when the Messenger was to be used on the CB band. Borrowing a scheme from commercial two-way radio design, I ran the dc input to the linear through a relay, the control voltage for which was carried by the inner conductor of the RG-58 coax feedline from the exciter. Isolation is pro vided at each end by 0.01 capacitors and rf chokes, as shown in **Fig. 1**.

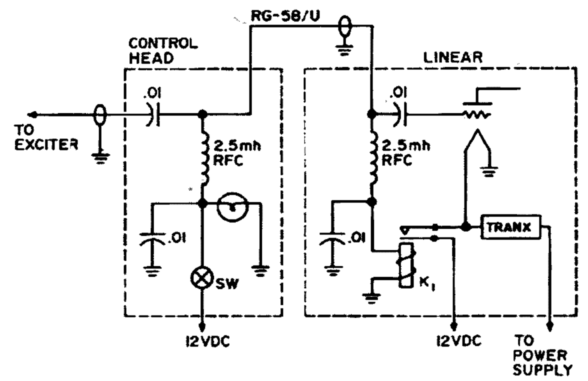


Fig. 1. Remote switching of linear amplifier.

Up front, the control head consists of a small aluminum bracket mounted under the dash, bearing the off-on switch, two capacitors and an rf choke, and a red indicating lamp to show when the linear filament is on.

Because of the low-impedance line, the rf chokes are completely effective in separating the dc from the rf–and operation is reliable and loss-free.

R. B. Kuehn WØ HKF

Using Microwave for Repeater Links

Technical considerations in using microwave links for interconnecting fixed VHF repeaters

Not too many years ago, "higher frequencies" referred to the VHF and UHF bands, with the then-new concept of line-of-sight propagation. Then came the microwave frequencies – 2, 4, and 6 GHz – where the signal behaved even more like a light beam. Each frequency "plateau" required new approaches to systems as well as hardware design.

Path Considerations

In many ways, the higher microwave frequencies behave just like the lower ones. The path-attenuation calculations, for example, are identical. For a given path, they show that a 12 GHz signal has 6 dB more path attenuation than a 6 GHz signal. On the other hand, the gain of a parabolic antenna of given size is 6 dB higher at 12 GHz. Since both the transmitting and receiving antennas are involved, the 12 GHz signal would appear to have a 6 dB advantage. In practice, however, this advantage is essentially canceled by higher receiver noise figures and higher waveguide losses at 12 GHz.

Selective fading at the higher frequencies can be effectively combatted by methods used at lower frequencies. Space diversity, for example, with its redundant transmission paths, substantially increases path reliability.

The effect of selective fading varies only slightly with frequency. For any given path reliability, the required fade margin in the 11 GHz band is at most a few dB greater than that needed at the lower frequencies.

Slightly less path clearance is required at the higher frequencies because the Fresnel-zone radii are smaller. Except in critical cases or on short hops, however, the difference is not likely to be very significant. For instance, on a 20 mile, 6.175 GHz hop, the first Fresnel-zone radius at 10 miles is 64.9 ft. If the frequency on the same hop is increased to 11.2 GHz, the radius decreases by only 16.8 ft.

Effects of Precipitation

Rain attenuates a microwave signal in two ways: the water absorbs energy, and the droplets scatter it. The severity of the attenuation is a function of the drop size, the temperature, the volume of water involved, and the signal frequency. The most significant part of this complex relationship can be summed up this way: the harder it rains, the bigger the drops, and the higher the frequency, the more severe the attenuation will be.

Of course, other forms of atmospheric moisture also affect signal attenuation, but rain is usually the dominant factor. Fog

and mist are essentially light rain. Attenuation due to hail is only a small fraction of that caused by rain. The effect of snow varies widely, depending on the moisture content, the flake size, and the temperature; but snow generally carries a much lower volume of water than rain does.

At the higher frequencies, heavy rain can be a real problem. The theoretical curves of Figs. 1 and 2 show how frequency would increase excess path loss if the rainfall rate were constant along the path. While actual rainfall rates are never uniform along the entire path, a hypothetical example based on Fig. 1 gives some feel for the effect of extremely heavy rain (4 in. per hour) on signals of different frequencies.

A 6 GHz signal, with an excess path loss due to rain of only about 1.2 dB per mile, would be attenuated by about 24 dB over a 20 mile hop. That is certainly significant, but it is within the operating capability of a system engineered with, say, a 40 dB fade margin.

A 13 GHz signal, on the other hand, would suffer rainfall attenuation of about 240 dB.

As shown in Fig. 2, a rainfall of 0.6 in. per hour would cause excess path loss of only about 1.1 dB per mile at 13 GHz – roughly the same as the 6 GHz signal would suffer at the much higher rainfall rate.

The trouble with curves such as these is that they fail to take into account the changing nature of heavy rain.

Local Rainfall Distribution

It is relatively easy to measure the effect of rain on a microwave path. The difficulty arises in trying to measure the rainfall rates along the path for accurate correlation with the attenuation measurements. The harder it rains, the more likely it is that the rainfall rate will show wide and almost instantaneous variations. Furthermore, there may be very heavy rain at one point, and almost none a short distance away.

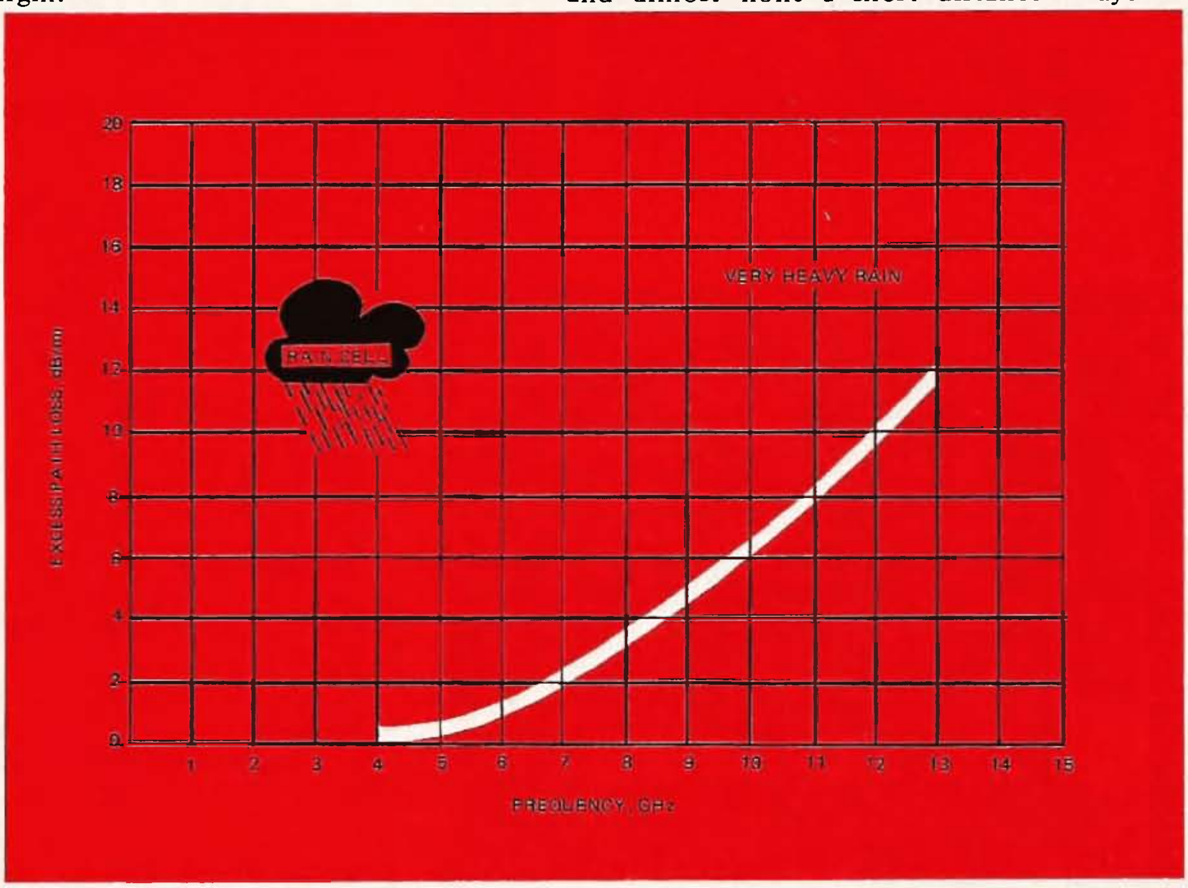


Fig. 1. Excess path loss caused by heavy rain increases rapidly with increasing frequency.

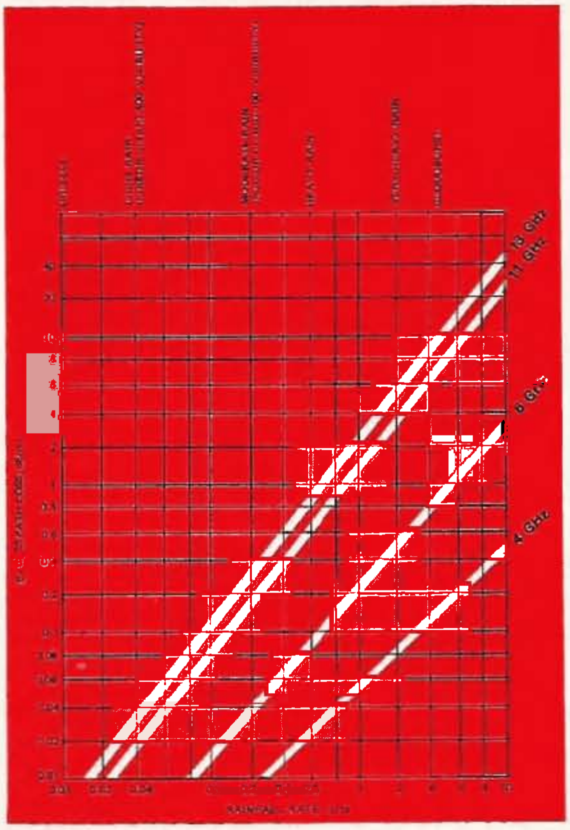


Fig. 2. Theorectical curves show how attenuation increases with rainfall rate (based on calculations by Ryde and Ryde).

The cumulative figures for the total length of a microwave path are often irrelevant.

Much work has been done in recent years on the nature of rainfall patterns. The results are not conclusive, but they indicate that the most intense rain, the rain that significantly affects microwave propagation, occurs in relatively small cells. Available evidence indicates that these cells rarely exceed a few miles in diameter, and the rainfall rate varies even within the cell.

This variation means that even an intense cell may not block a microwave path for the entire time it takes to cross the path. A five mile wide cell moving at 20 mph takes 15 minutes to cross a particular path at right angles. But it is unlikely to block the path completely for 15 minutes.

Rainfall Distribution

Paradoxically, some geographical regions known for their large annual rainfall (such as the rain forests of Oregon and Washington) do not present as difficult a transmission problem as do other "drier" areas. The reason is, of course, that the total annual rainfall is of little consequence. *Concentrated* rain causes the trouble. The significant questions are: How heavy are the rainfall rates that can be expected? How often can such rates be expected?

The problem in any area is complicated by the fact that although much information is available on *annual* rainfall, very little is known about *instantaneous* rates. Gradually, however, the body of knowledge has built up so that it is now possible to generalize about many geographical areas.

Figures 3 and 4, the results of empirical studies, indicate generally how expected outage time varies with geography in the United States. For example, an 11 GHz path, 30 miles long and engineered for a 40 dB fade margin, would have an expected outage time of about 0.2 hour per year on Washington's Olympic Peninsula (contour H). This translates to a reliability of 99.998%.

If the same path were located on the coast of the Carolinas (contour C), the predicted reliability would drop to 99.92% because the expected outage time would increase to 7 hours per year.

Now consider the same path on the Gulf Coast of Mississippi (contour A) and assume that the expected annual outage time must be held to the same 7 hours. The path would have to be shortened from 30 miles to 22 miles, or the fade margin would have to be increased substantially.

It must be remembered that these calculations are for a single hop. The outage time for the entire system can be expected to equal the sum of the single-hop outages. In terms of reliability, 10 hops with 99.99% reliability form a system that is only 99.9% reliable.

Diversity Arrangements

Heavy rain is not the only thing that will put a microwave system temporarily out of business. The mechanisms of selective fading are completely separate from those of rainfall attenuation. When the effects of rainfall attenuation cannot be completely controlled, one way to keep

Fig. 3. The contours of this map are for fixed transmission outage time and can generally be used in conjunction with the curves of Fig. 4 to predict the effect of rainfall on path reliability.

reliability high is to pay special attention to selective fading.

Perhaps the ideal solution would be route diversity: sending the same signal over two paths separated by several miles. In practice, however, route diversity is too expensive to justify. Equipment and installation costs for communication links are quite high, not to mention the difficulty encountered at the receiving end in trying to combine the signals from two paths of substantially different length.

Conservative Engineering

There is no easy, clear-cut way to avoid problems with rain. The most effective defense is a combination of techniques. And conservative engineering is the first one. A marginally engineered system is an invitation to excess outage time.

One thing that can be done, for example, is to increase the fade margin. This does not guarantee transmission through the heaviest rain, but it does effectively lower the expected outage time.

Because of variations in the instantaneous rainfall rate, it is not always possible to specify exactly how much effect a higher fade margin will have on rainfall attenuation. But some idea can be gained from a hypothetical example like this: Suppose a particular 11 GHz microwave hop can withstand an average rainfall along the path of 1 in. per hour – an excess path loss of about 1.3 dB per mile. If the fade margin is then raised by 5 dB, the hop can still withstand the 1 in. per hour rain along the path, except for a two mile segment where it passes through a rain cell. In that segment, it can withstand excess path loss of 3.8 dB per mile – equivalent to a rainfall rate of over 2 in. per hour (see Gig. 6). In many areas, that much improvement will not eliminate rainfall outages. But it will reduce them.

Of course, increasing the fade margin may not always be desirable. If it means in increase in the number of hops, for instance, any gains in path reliability may be more than offset by the decrease in equipment reliability as more transmitters and receivers are added.

Equipment reliability is equally as important as path reliability. So is the reliability of the power source. And good maintenance is important, too. Improving the reliability of any one of these naturally improves the end product – total system reliability. Thus, economics is the common denominator in improving system reliability.

The higher frequencies which can provide bandwidths suitable for translators or multiple, individually controllable repeater links are unused, waiting to be tapped. They range in a continuous spectrum from

the microwave frequencies through millimeter waves and infrared to the visible light region. Eventually, they may even include the ultraviolet range. The problem is finding a way to use them in practical communications systems.

Atmospheric Considerations

Since rainfall attenuation is one of the most significant problems in the 11 GHz band, and the effect increases with frequency, the problem can be expected to be even more severe at higher frequencies. Figure 7 shows theoretical rainfall attenuation as a function of rainfall rate for selected frequencies up to 40 GHz. (Some empirical studies have indicated even higher attenuation than predicted.)

While rainfall attenuation is still the most significant atmospheric problem, fog and mist become increasingly important at the higher frequencies. The deciding factor is the volume of water in the air, which is perhaps easiest to understand in terms of visibility. At 30 GHz, for example, fog that cuts visibility to 150 ft attenuates the signal by about 0.5 dB per mile. It takes more than twice the moisture concentration to reduce the visibility to 100 ft at which point attentuation is about 1.6 dB per mile.

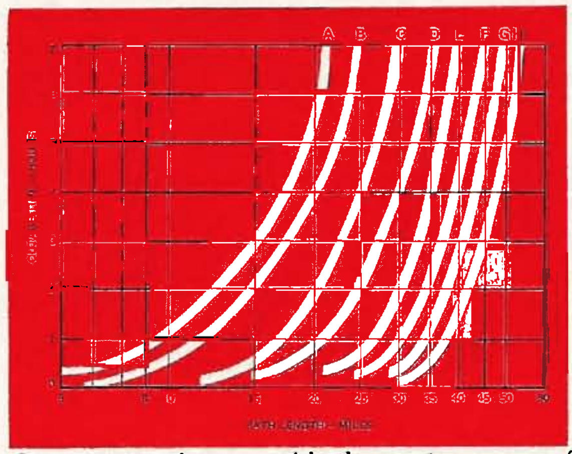
In this frequency region, another phenomenon – molecular absorption of the radio energy – also becomes a problem. Water vapor (not to be confused with water droplets) absorbs more energy as frequency increases, with a significant absorption occurring at resonant peaks. One such peak is at 22.4 GHz. At this frequency, a relative humidity of 60% produces absorption of about 0.4 dB per mile. At 18 GHz, the same humidity absorbs energy at the rate of only about 0.05 dB per mile.

Another minor effect is the molecular absorption of oxygen, which also increases with frequency. The loss only becomes significant, however, at frequencies in the 50 GHz range.

Modulation Techniques

The frequency allocations for present-day microwave systems are intended primarily for equipment that uses low-deviation FM, with rf bandwidths of 20 MHz or less. This technique is well suited for voice traffic, which is usually multiplexed by frequency division. But, the nature of the traffic carried by microwave radio is being changed by two major factors. One is the tremendous increase in data communications, and the other is the increasing use of pulse-code modulation (PCM) for voice communications. The two are essentially the same from the microwave engineer's point of view. Either way, he is faced with the necessity to transmit pulses at a high rate. One method is to use digital microwave transmission. Such a system becomes one more step in the time-division multiplex scheme.

Fig. 4. Expected path degradation varies greatly with changing geographical rainfall distribution.



These curves, for use with the contour map of Fig. 3, are based on 11 GHz paths with 40 dB fade margins.

An advantage of PCM is its relative immunity to noise. Because it is only necessary to detect the presence or absence of a pulse in a particular time slot (not its height, shape, or any other characteristic), a PCM system can operate at a very low signal-to-noise ratio. Consequently, it is quite tolerant of the severe atmospheric attenuation.

Millimeter-Waves

The millimeter-wave region, from 30 to 300 GHz, is very attractive for wideband communications systems because of the tremendous bandwidth available. At these frequencies it is not at all unreasonable to think in terms of a 2 GHz baseband that

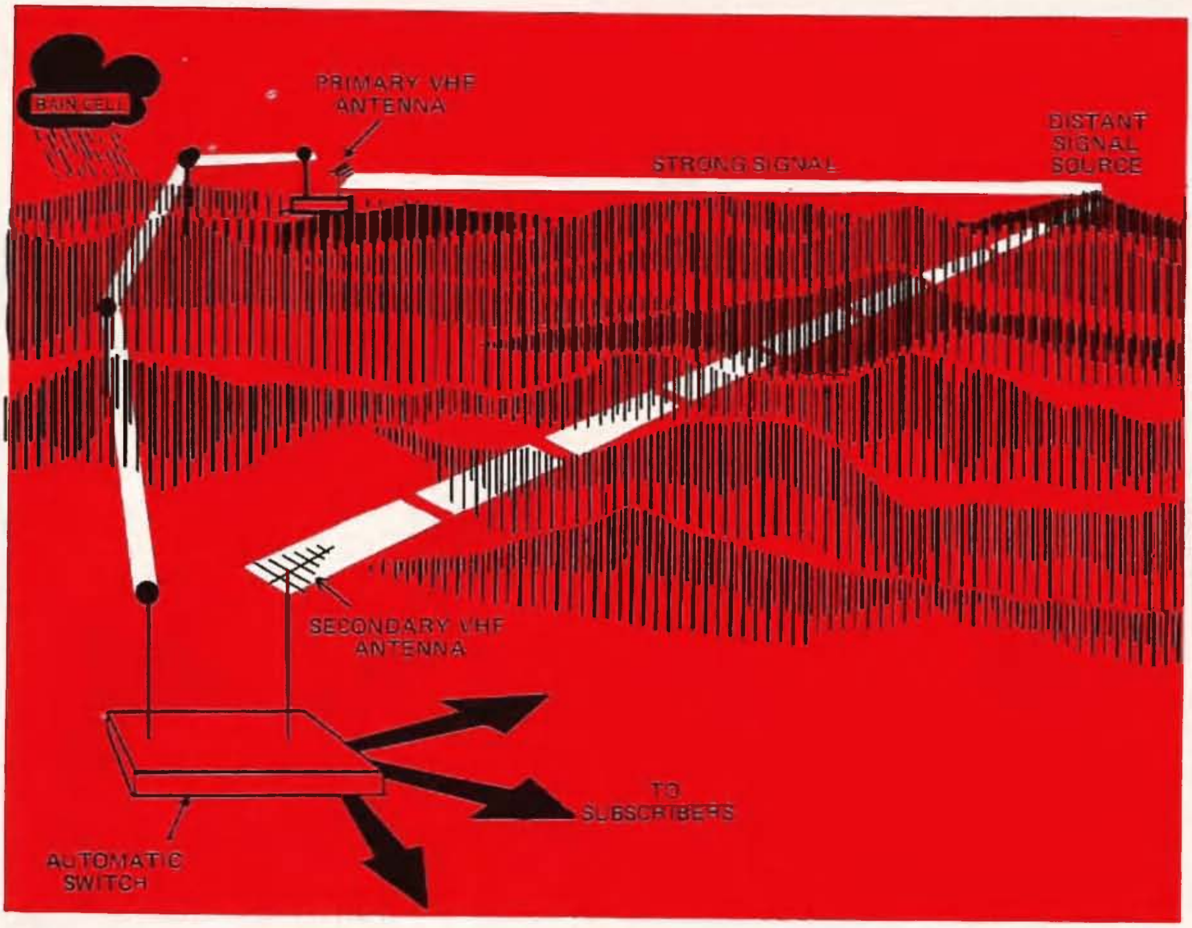


Fig. 5. Many CATV systems can use a secondary off-the-air antenna as a back-up for a microwave link.

could, in theory, accommodate over 200,000 voice channels – or the equivalent in other forms of communications.

Of course, the problems of atmospheric attenuation are exceptionally severe at these frequencies. In fact, transmission through the atmosphere may not be practical except for certain applications. One such case is satellite communications.

Laser Transmission

Few people have been more excited over the useful possibilities of lasers than have communications engineers. The reason for their excitement is quite simple: the information-carrying potential of any communications channel is proportional to its operating frequency. Because lasers operate in a frequency range about 100,000 times higher than today's microwave radio systems, they have the potential to carry 100,000 times more information.

But, potential is sometimes far from reality. While laser beams have been used to burn through steel in industrial applications, their penetration range is limited. They are still light beams, and light beams do not penetrate very far through heavy clouds and other atmospheric obstructions. For this reason, unprotected laser transmission is practical only for short distances or in space communications. Long-range laser communications systems will have to fllow an optically aligned tube. Here difficulties arise when the beam is bent – even enough to follow the curvature of the earth.

Therefore, any practical system will probably use a series of lenses to refocus the beam and change its direction slightly. In so doing, they will act somewhat as passive repeaters. Optical lenses can be used, but even the highest quality ones introduce substantial losses.

However, considerable promise is being shown by gas lenses. Such a lens can be formed by gas flowing through a heated tube. Because the gas is warmer near the tube wall and the cooler gas in the center is

denser, it acts as a lens causing the beam to converge. The advantage of this type of lens is that it places no solid surface in the path of the light beam. Therefore, the loss introduced by the lens is only that caused by the gas molecules scattering the light beam.

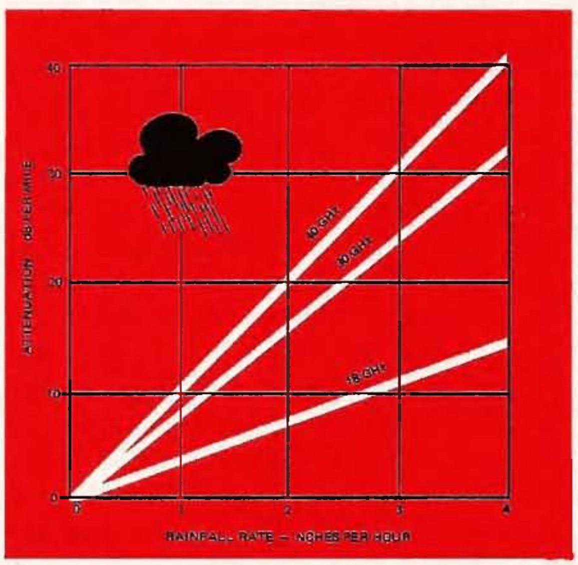
This principle sounds simple, but there are substantial obstacles to be overcome. A big problem is presented by the extremely critical mechanical tolerances required of a lens waveguide. The costs may make such an arrangement impractical.

Transmission is not the only area that presents problems for a laser communications system. Another hurdle is modulation and demodulation – and the associated area of multiplexing and demultiplexing.

One of the most promising modulation techniques is PCM – primarily because a laser can produce high pulse rates and very narrow pulses. If a laser beam is split as shown in Fig. 8, parts of it can be sent to parallel modulators to form similar trains of narrow, relatively widely spaced, pulses.

Fig. 6. Raising the fade margin by 5 dB, (as in B above) can permit transmission through a rain cell of substantially greater intensity.

Fig. 7. Attenuation caused by rain can be a formidable problem at the higher microwave frequencies. These theoretical curves (after Ryde) should be used only as approximations. Some measurements have indicated substantially higher attenuation.



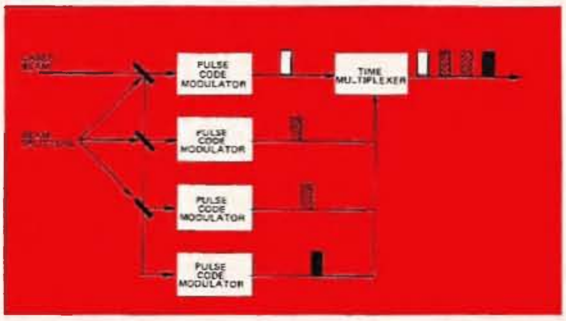


Fig. 8. PCM shows considerable promise for modulating lasers. The beam-splitting arrangement shown here forms several high-speed channels from a single laser beam.

These pulse trains can then be interleaved for time-division multiplexing.

It is theoretically possible to add more multiplexing steps. If, say, 100 time-multiplexed signals were frequency multiplexed, the capacity would increase 100-fold. It is then conceivable that still another form of multiplexing, called spatial multiplexing, could be used. This means sending a number of beams simultaneously through a waveguide in different propagation modes.

Such a system does not exist, and may never exist. However, a system has been suggested that would time-multiplex 32 channels in each of two polarization states, then frequency multiplex 100 of these "super channels," and finally use spatial multiplexing to combine 100 such beams.

The theoretical capacity of such a system staggers the imagination. The suggested bit rate would be about 2×10^{14} bits per second – the equivalent of 1,920,000 video signals.

The world has hardly begun to tap the potential of communications. It is not clear just what form the future uses of communication will take. But it is clear that man's capacity to devise communications systems has not been reached and the future is virtually unlimited.

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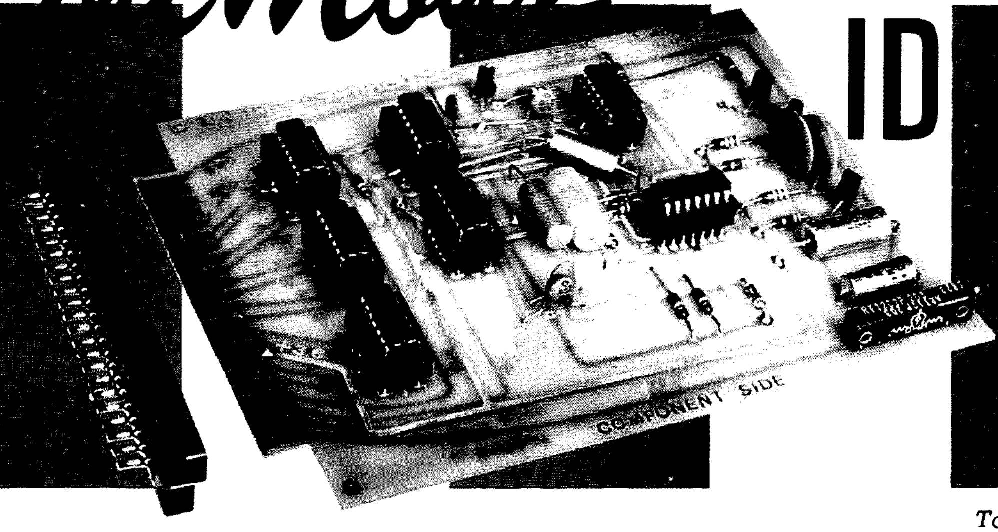
The Mod 2 DIGITAL ID IT



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The reliability of most electromechanical repeater identifiers leaves something to be desired. In many cases an amateur repeater will operate as many as 500 times a day. According to a recent FCC ruling, each repeater must be identified at least every three minutes of operation. This means that the repeater may be identified just as many times as the repeater is operated. Most electromechanical devices such as relays, code-wheel devices, and tape decks cannot withstand the constant on/off operation of repeaters for any great length of time. Remember, those devices were for intermittent use – the code wheel for distress signals; the tape deck for listening pleasure, and so on. None of these devices were made to take the constant on/off use that is needed, let alone the environmental conditions.

One only has to climb to the mountaintop site after the first snow of the season because of an identifier failure to realize there ought to be a better way! Why not make the identifier solid state and eliminate those moving parts that wear out? Better still, why not use integrated circuits to accomplish the task? With a parts cost of less than $20, the Morse code digital identification unit (DIU) described herein does just that and it will outlast anything mechanical that you might otherwise put on top of a mountain.

The System

The DIU is unique in that it uses a simplified computer address principle for selecting the information it is programmed to send. There are four basic units in the DIU:

- Counter
- Matrix (memory)
- Signal logic
- Oscillator

The counter establishes which sequence is next. The matrix determines what instruction is next by the sequence. The signal logic converts the instruction information into the actual signal to be sent. The tone oscillator sends the requested signal. The whole system is based on a closed loop and therefore no standard clock is employed in the logic.

Logic Terms

To understand how the DIU works we must first become familiar with some of the simple logic terms that the system is based on.

High: Maximum output of logic unit (at least +1.5V)

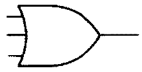
Low: Minimum output of logic unit (less than +0.5V)

Inverter: Device used to produce opposite logic state of what is applied to it. Example: +2V into an inverter would

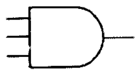
produce a 0V output while a 0V input would produce a +2V output.

Symbol: 

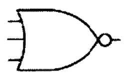
Or gate: Device used to give a high output when any of its input lines are high. Example: 3 input lines; one at +2V, the other two at 0V produces a +2V output on the output line of the gate.

Symbol: 

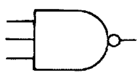
And gate: Device used to give a high output when *all* input lines are high. Example: 3 input lines; +2V on all 3 input lines of gate produces a +2V output on the output line of the gate.

Symbol: 

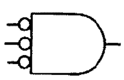
Nor gate: An inverted *or* gate; device used to give a low output when any of its input lines are high. Example: 3 input lines, one at +2V, the other two at 0V, produces a 0V output on the output line of the gate.

Symbol: 

Nand gate: An inverted *and* gate; device used to give a low output when *all* input lines are high. Example: 3 input lines, +2V on all 3 input lines of gate, produces a 0V output on the output line of the gate.

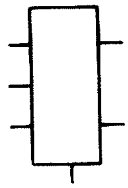
Symbol: 

For this article, *nor* gate logic was used to implement the *nand* functions; therefore, the definition for our purpose of a *nand* gate is a device used to give a high output when all of its input lines are low. Example: 3 input lines, 0V on all three input lines of a gate, produces +2V output on the output line of the gate.

Symbol: 

Note that the zero placed before or after the inverter, *nor*, and *nand* logic gates defines the expected state of the input or the output for the function to occur.

Flip-flop: A device used to store information a bit at a time. In the DIU application, a string of flip-flops is used as a counter. The purpose of the counter being to sequentially address the required instructions for the DIU.

Symbol: 

Unit: Smallest bit of information sent by the DIU (dih, dah, or blank).

The DIU uses the MC700 series of Motorola integrated circuits due to their inexpensiveness and availability.

System Operation

A 0V signal through the start network (see Fig. 1) from the transmitter keying circuit resets all the flip-flops in the counter to the zero state. All Q' lines become high and all Q lines become low. Approximately 2V and 0V are fed into the diode matrix, which decodes the counter number into an instruction for the oscillator keying logic. In the DIU there are four basic instructions: (1) send a dit, (2) send a dah, (3) send neither dit nor dah (blank), and (4) stop.

If the diode matrix decodes the first sequence count (0) to be instruction number 1 (send dit), the dit signal line from the matrix will be high. This will cause the dit inverter to have a low output and one-half of the "dit enable" gate will be enabled. Since the space line is also at "low" level at this time, a trigger pulse will be sent through capacitor C7 to the "dit" one-shot. (A one-shot is a monostable device used to generate a predetermined pulsewidth.) The dit time pulse determined by the one-shot is sent through the "dit or dah" gate and the "dit or dah/blank" gate to enable the "dit or dah send" gate. The *nand* gate keys the oscillator circuit to produce the dit signal.

At the same time the dit is being sent by the one-shot to the oscillator, the "space" one-shot logic is being reset via the "dit, dah, or blank" gate, inverter, and "space enable" gate.

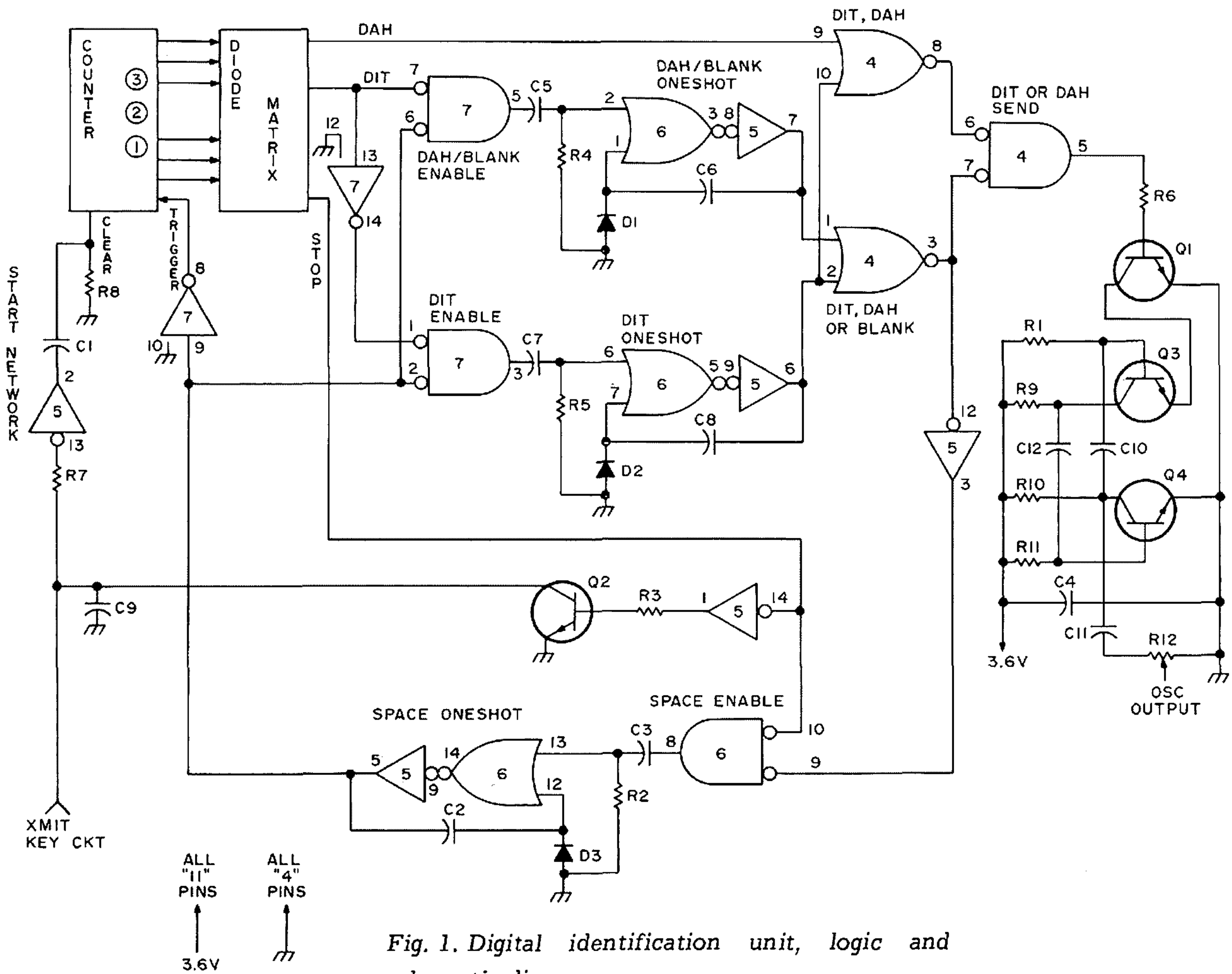


Fig. 1. Digital identification unit, logic and schematic diagram.

Upon completion of the dit signal, the "dit, dah, or blank" gate becomes high, making the inverter output low. Since the stop instruction has not been called for by the matrix, the "sapce enable" gate produces a high output. The high output in turn sends a pulse through capacitor C3 to trigger the "space" one-shot. (The space time period is used to separate the units of a letter. Example: D = dah-space-dit-space-dit.

The space period is the same as the period for the dit. The space signal, besides allowing for the time to distinguish the units of a letter, advances the counter through an inverter to the next unit and resets the "dit" and "dah" one-shots by discharging capacitors C5 and C7.

If the diode matrix decodes the next sequence to be instruction 2 (send dah), the dah signal line from the matrix will become high and the dit signal line will become low. When the space line becomes low, the "dah/blank enable" gate will send a pulse through capacitor C5, triggering the "dah/blank" one-shot. The dah/blank pulse would then go through the "dit or dah/blank" gate while the dah signal from the matrix would go through the "dit or dah" gate. These two gates would then enable the "dit or dah send" gate to trigger the oscillator for the dash period. The "space" one-shot is again triggered to advance the counter to the next unit.

If the diode matrix decodes the next sequence to be instruction 3 (send a blank), neither the dah nor dit line will become high. The same will occur as above for the dah except that when the signal reaches the coincidence gates the "dit or dah" gate will not be enabled. Thus the oscillator will not be keyed. This generates the blank period which is put between letters. (Example: DE = dah-space-dit-space-dit-blank-dit-blank) Again the loop through the "space" one-shot is triggered and the counter is advanced to the next unit of information.

The counter is advanced each time a unit of information is sent until it is advanced to the "stop" instruction. This instruction causes a blank to be automatically sent and stops the "space enable" gate from triggering the space one-shot. The DIU remains in the stop state until a reset pulse is sent to the counter from the transmitter keying circuit and the whole process starts over again.

Of course the DIU works much faster than it can be described. Depending on the component values selected for C2, C6, and C8, the DIU can function at any reasonable speed. The particular values used in the prototype and listed for Fig. 1 (see Table I) causes the unit to identify at the rate of 42 wpm (2 seconds for DE W6FNO). If a faster or slower rate is desired, capacitor values should be changed accordingly. It should be noted, however, that C8 must be three times as large as C2 and C6 to give the proper character formation. This is a critical relationship and follows from the fact that a space and dit are identical in time length while a dah or blank is three times the length of a dit.

Transistor Q2 is used to lock on the transmitter keying circuit while the digital identification unit is sending its identification code. If a timer is used in conjunction with the identifier, the transmitter will be keyed for the duration of the identification every time the DIU is reset. This allows a complete sending of the identification regardless of whether the transmitter remains keyed by an external circuit such as a COR (carrier-operated relay) or not. If this feature is not desired, Q2 should not be installed.

Table I. Parts list for DIU Logic Board and Diode Matrix

DIU Logic Parts	
R2-8	**10 K ¼W**
R9, R10	**3.3K ¼W**
	R1, R11r33K ¼W
C1, C3, C5, C7, C9	**.05 μfd disc 25V**
C10, C12	**.008 μfd disc 25V (1000 Hz)**
C2*, C1, C8*	**10 μfd/15V**
C4, C6*	**30 μfd/15V**
	***Most change in direct ratio**
IC1-3	**Motorola 791P**
IC4,6,7	**Motorola 724P**
IC5	**Motorola 789P**
Q1-4	**2M3415 or equivalent**
D1-3	**1N34 or equivalent**
IC sockets wire-wrap type	**Vector R-714**
22 pin PC socket	**Vector R-644**
Matrix Parts	
10-20 resistors	**3.2K ¼W**
60-100 diodes	**ge or si (all same type)**
22-pin PC socket	**Vector R-6⁄**

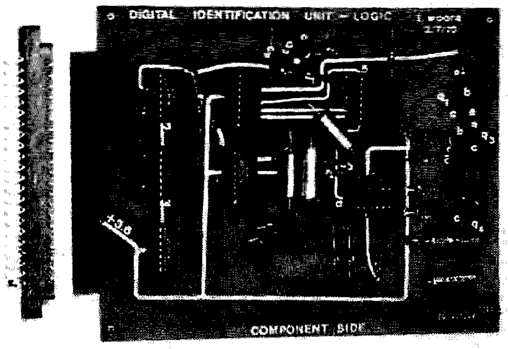
0 1 2 3 4 5 6 7 8 9 10 11 12 13
X ▬ • • X • X X • ▬ ▬ X ▬ •
14 15 16 17 18 19 20 21 22 23
• • • X • • ▬ • X ▬
24 25 26 27 28 29
• X ▬ ▬ ▬ Stop

Fig. 2. Unit breakdown diagram.

Transistor Q1 is used to key the oscillator, while Q3 and Q4 – along with the feedback and bias networks – make up the oscillator. The oscillator was designed to be fed directly to the grid of the modulator in the transmitter.

The Diode Matrix

Up until now very little has been said about the diode matrix other than the fact that it determines what instruction to give the keying logic. The actual construction of the matrix can be considerably simplified and consequently cheaper. Up to 70% of the diodes necessary for the diode matrix can be eliminated by using mathematics. A much more sophisticated, economical, and space-saving layout can be achieved using Boolean algebra. Thanks to Mr. Karnaugh, it is not necessary to give a complete discussion on Boolean algebra.



The IC logic board is shown here from the component side. Note the use of IC receptacles, which simplifies test, checkout, and replacement.

The Karnaugh map is a device for mechanically determining the mathematical equivalent of the diode matrix. For the purpose of this discussion the MCW message will be "DE W6FNO." Of course, any other message can be developed by this method and consequently this discussion may be used for developing any matrix logic.

The first step in determining the diode matrix for the message is to break up the message into the units to be sent: • = dit, — = dah, x = blank. This is shown in the breakdown diagram Fig. 2.

It is seen that 30 units of message will be sent (0 is actually used for a blank). To convert units 0 to 29 into a diode matrix, the Karnaugh map is used (see Fig. 3).

The numbers in the boxes correspond to the decimal equivalent to units on the output of the counter. The numbers across the top and along the side of the chart correspond to the binary output of the flip-flops — 1 for true or 0 for false. The letters written diagonally in the top left corner refer to the six flip-flops. Example: Box 17 has flip-flop A tue, B false, C false, D false, E true, and F false. Written in Boolean form, 17 would be represented by AB'C'D'EF', where the apostrophe after the letter indicates that the flip-flop is false and, conversely, a letter without an apostrophe is true.

To simplify the matrix, a Karnaugh map is constructed separately (Figs. 3 and 4) for the dits and dahs to be sent. From Fig. 2, units 2, 3, 5, 8, 13, 14, 15, 16, 18, 19, 21, and 24 represent the dits to be sent in the message. In the dit Karnaugh map (Fig. 4) a 1 is placed in each box corresponding to the number. An X (not the X which represents a blank) is placed in all boxes after the stop code number. These are "don't care" conditions because the counter will not count to these codes.

From the dit Karnaugh map (Fig. 5) it can be seen that the third unit of information is a dit and that flip-flop A is true, B is true, C is false, D is false, E is false, and F is false, or ABC'D'E'F'. To put this in matrix form, the Boolean algebra tells us that this dit would be represented by a diode connected to Q_a lead (the true lead of flip-flop A), another to Q_b, another to

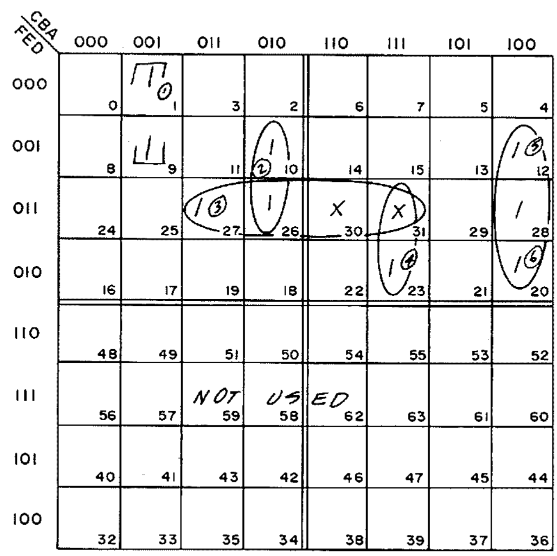


Fig. 3. Karnaugh map of dahs to be generated in DE W6FNO.

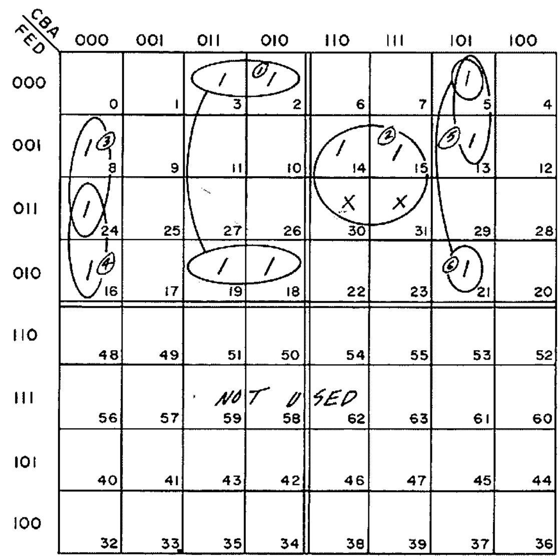


Fig. 4. Karnaugh map of dits to be generated in DE W6FNO.

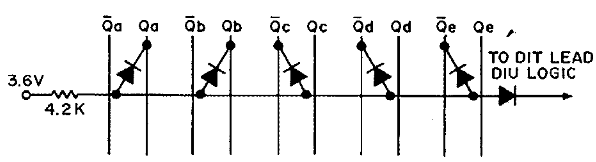


Fig. 5. Unit 3 information — dit.

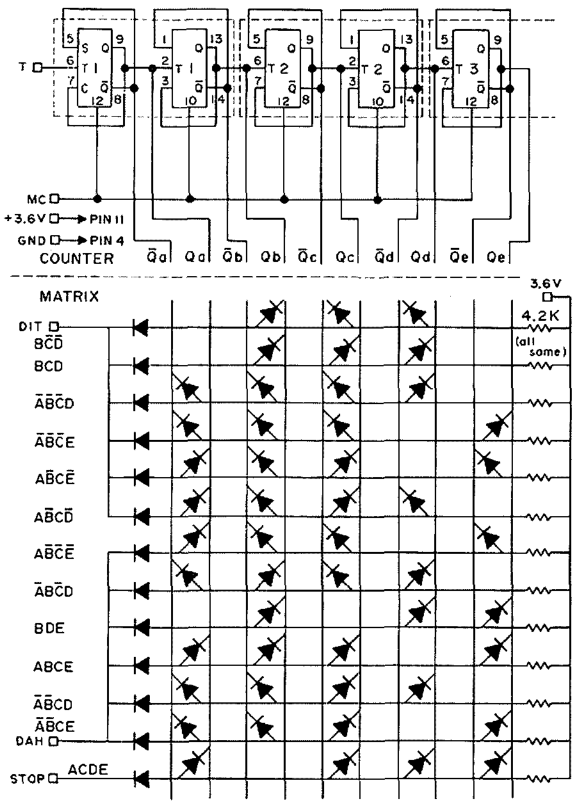


Fig. 6. DIU matrix and counter

Q_c' (the false lead of flip-flop C), another to Q_d', another to Q_e'. Since there are only 30 units of information, flip-flop F is not used. A line may be used over any of the symbols to indicate the same thing as an apostrophe. It would normally take six diodes (seven when the F flip-flop is used) to send this unit of information. See Fig. 6.

Actually, it would take six diodes (seven when the F flip-flop is used) for each unit of information in the message or 29 x 6 = 174 diodes. This includes the diodes needed to *or* the dahs together and the dits together. This is where the Karnaugh map saves diodes. Again on the amp in Fig. 4 any adjacent box or any box that changes just one variable from another box eliminated that variable. Boxes 8 and 24 simplify to A'B'C'D, eliminating the E flip-flop altogether. Boxes 3, 2, 19, and 18 also simplify since they change one variable at a time or BC'D'. Note that not only is 3 represented by BC'D' but also 2, 19, and 18, resulting in a savings of 20 diodes – 4 numbers x (5+1or) –(3+1or used) = 20. 14 and 15 combine with "don't cares" 30 and 31 to equal BCD. The final expression though not the only expression that will work) for the dits is BC'D' + BCD + A'B'C'D + A'B'C'E + AB'CE' + AB'CD'.

Figure 3 was used to develop the dah equation which is AB'C'E' + A'BC'D + BDE + ABCE + A'B'CD + A'B'CE. 28 diodes were used to develop the dit matrix, 29 were used for the dah matrix, and 5 were used for the stop code, giving a total of 62 diodes for the entire matrix. Quite a few less than 174!

The final matrix appears in Fig. 6 for the message DE W6FNO. Note that any matrix of this magnitude can be determined by the above method. To expand to 64 units of information the mirror image of the first 32 units is used in the Karnaugh map. In Figs. 3 and 4 the "not used" portion would be used. The upper portion of Fig. 6 illustrates the wiring of the counter; note that it mates to the leads of the matrix.

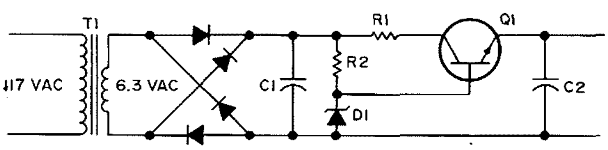
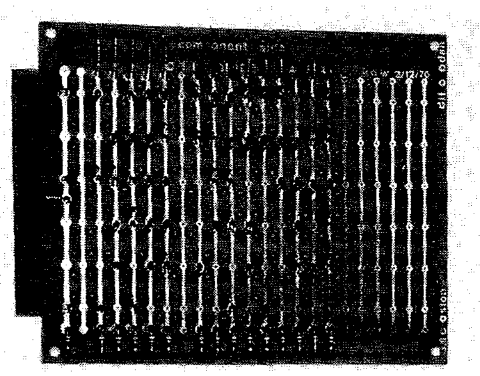


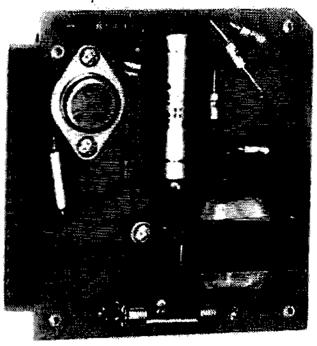
Fig. 7. DIU regulated power supply.

Construction of the DIU

Since the publication of the first article on the DIU numerous people have sought printed circuit boards for the unit. In order to obtain the DIU logic, matrix, or power supply boards, write to Keith Whitehurst, Box 538, Claremont, Calif. 91711.



This photo of the call letter matrix board shows the layout of the diodes for W6FNO. The same board is used for other calls, though the diode placement will vary.



Regulated power supply module provides +3.6V to digital, identifies logic and matrix boards.

Table II. DIU Regulated Power Supply Parts List.

T_1	**Stancor P6465 117 to 6.3V, 600 mA.**
D_1	**3.9V Zener 1N748 Motorola**
D	**1A 12V diodes or HEP Bridge**
C_1	**1000 μF at 12V**
C_2	**200 μF at 12V**
R_1	**10 Ω at 6.3V 5 Ω at 3.2V**
R_2	**220 Ω at 6.3V input, 110 Ω at 3.2V input***
Q_1	**2N4921 or HEP 245**

Power Supply

Figure 7 illustrates the schematic of the DIU power supply. Table II lists parts required. Any power supply, however, may be used if the power output is 3.6 V with less than 5% ripple (including voltage spikes).

Installation

The signals normally received and sent to and from the DIU should meet the following criteria:

1. From power supply – 3.6V dc, well filtered and regulated.
2. From transmitter keying circuit – 0V, transmitter keyed; approximately 6V transmitter unkeyed (filtered).
3. To transmitter keying circuit – identifier off: 10 MΩ; identifier keyed: 10Ω.
4. To modulator circuit – high impedance DIU oscillator output.

Note that all dc input lines to the DIU logic should be filtered. In some relay circuits the output of a bridge rectifier is used to directly key the transmitter relay. So the pulsating dc does not key the digital identification unit, a 60 μF capacitor (or greater) should be placed across the relay supply.

It is worthwhile to note that the original prototype, after two and a half years, is still operational atop Johnstone Peak in San Dimas, California, sending out for all to hear – DE W6FNO. . . . WB6BFM ■

testing the NCX-1000

by Wayne Green W2NSD/1

After five years of making waves on the DX bands with a transceiver plus great big linear amplifier, it takes some getting used to, making virtually the same waves with a little box that I can lift with one arm . . . well, two arms . . . it weighs 59 pounds. And that includes the built-in power supply and loudspeaker.

The NCX-1000 is sure a far cry from the first National rig that I owned way back in the dim, dark past. The National 600 was a 600 watt transmitter first marketed back in the late 30's. I still use the indestructible power supplies and modulator from the 600 in my two meter kilowatt. The rf sections are, sadly, no longer state of the art.

Well, to get back to the 1000, National has come up with a real beauty in this rig. It is all solid state except for the final stages of the transmitter and it works like a dream.

Being a knob buff, a fellow that enjoys having dozens of knobs to twiddle, I was at first taken aback by the simplicity of the front panel of the 1000. Surely National must have left off some controls that I would need. If they did I still haven't missed them.

How does the 1000 compare with other rigs? Well, I stacked it up against three other transceivers on my operating desk, all working through a nice linear amplifier, and started making comparison checks all around the world, through poor conditions, monumental interference, and such. While there did turn out to be times when the extra power of the big rig surmounted pileups a little faster than the 1000, these times were satisfyingly few. Generally the report is that the 1000 is better copy

If I had been using different types of microphones it might account for the better voice reports, but I used identical mikes for the tests. The engineers at National have emphasized the higher range of the voice a bit more than the other rigs with the result that there is more punch and, other things being equal, the 1000 is more readable.

The NCX-1000 covers the amateur bands from 10–80 meters and provides sideband with either side, AM, and CW. The receiver works so well that I suspect that National must have borrowed more than considerably from their very successful HRO-500 receiver for the design.

They have a clever speech processor built into the transmitter (switched on from the front panel) which operates at rf. In this circuit the single sideband of the first i-f is clipped by a diode limiter and then filtered to remove the unwanted distortion products. This increases the average power by a factor of two, resulting in almost the same average power output as a two kilowatt PEP transmitter. My tests, by the way, were made with this clipper off when I was comparing the 1000 with other rigs. With the clipper on the signal is even louder, and though it loses a bit on voice quality reports it certainly gains on punch through pileups.

CW operators will appreciate the vernier control which displaces the receiver ± 3 kHz from the transmitter. This is also handy on sideband when the other op misses your frequency or drifts away from it during the contact. It can keep you from chasing someone with a displaced trans-

mitter on down or up the band. An accessory vfo is available if you want to work split frequency more than 3 kHz. Hopefully, now that Gus is back in the U.S., little split frequency operation will be needed for a while.

It is strange that it has taken so long for solid state circuits to come to amateur sideband equipment. You don't find tubes in much new gear these days, except for amateurs. My car radio, FM receiver, television set, tape recorder, hi-fi, etc., are all solid state. Even the silly pencil sharpener is solid state! Out of one dozen 2m FM sets on the market, all are completely solid state except two....and both have one tube which will be superseded soon by an *all* solid state unit. Judging from the small size and light weight of the National 1000, solid state is certainly the way to go.

The 1000 covers all five amateur bands, 10–80 meters. An accessory 100 kHz oscillator plugs in for calibration of the tuning dial. The front panel meter functions as an S-meter on receive and reads plate current, screen current or plate voltage on transmit. AALC? Of course, and quite effective it is. The screen current meter function is excellent for rapid loading of the transmitter. I was able to tune it up in seconds . . . like the time I switched up from 80m to 20m and just happened to catch XT2AA (rare) calling CQ. Within three seconds I was tuned up and calling him. I made it.

The accessory 100 kHz calibrator also provides sidetone for CW operation. It can even be used for code practice, if needed! Obviously National has kept the CW ops in mind in the design of this rig . . . it covers all CW bands . . . and runs close to the legal limit to the 8122 final in this mode.

In all, the National 1000 seems to be well in keeping with the long history of excellent equipment that National has provided us down through the years. Many of us were concerned recently when their overdependence on government work forced them into bankruptcy. The company seems to be in pretty good shape now and is paying its bills, so perhaps they have weathered the depression.

. . .W2NSD/1■

BUILD YOU

All you have to do is look once at the price of commercial walkie-talkies to see how the effort of building your own can be justified. But there's a satisfaction that comes with operating something you've put together yourself, which goes well beyond the knowledge that you've beaten the manufacturers at their own game. I won't be foolish enough to tell you that building up a portable FM transceiver is a snap, because it frankly isn't quite that simple. But it really isn't particularly difficult either; and the time you spend will be amply rewarded by a good solid working knowledge of what's in those little radios you hold in your hand. Besides, it can be great fun!

The construction process is described here in its entirety – first, the receiver, then the transmitter. But since the project is to be a miniaturization job as well as simple construction, there are certain specifics involving components that must also be considered. In the main, these are dealt with individually.

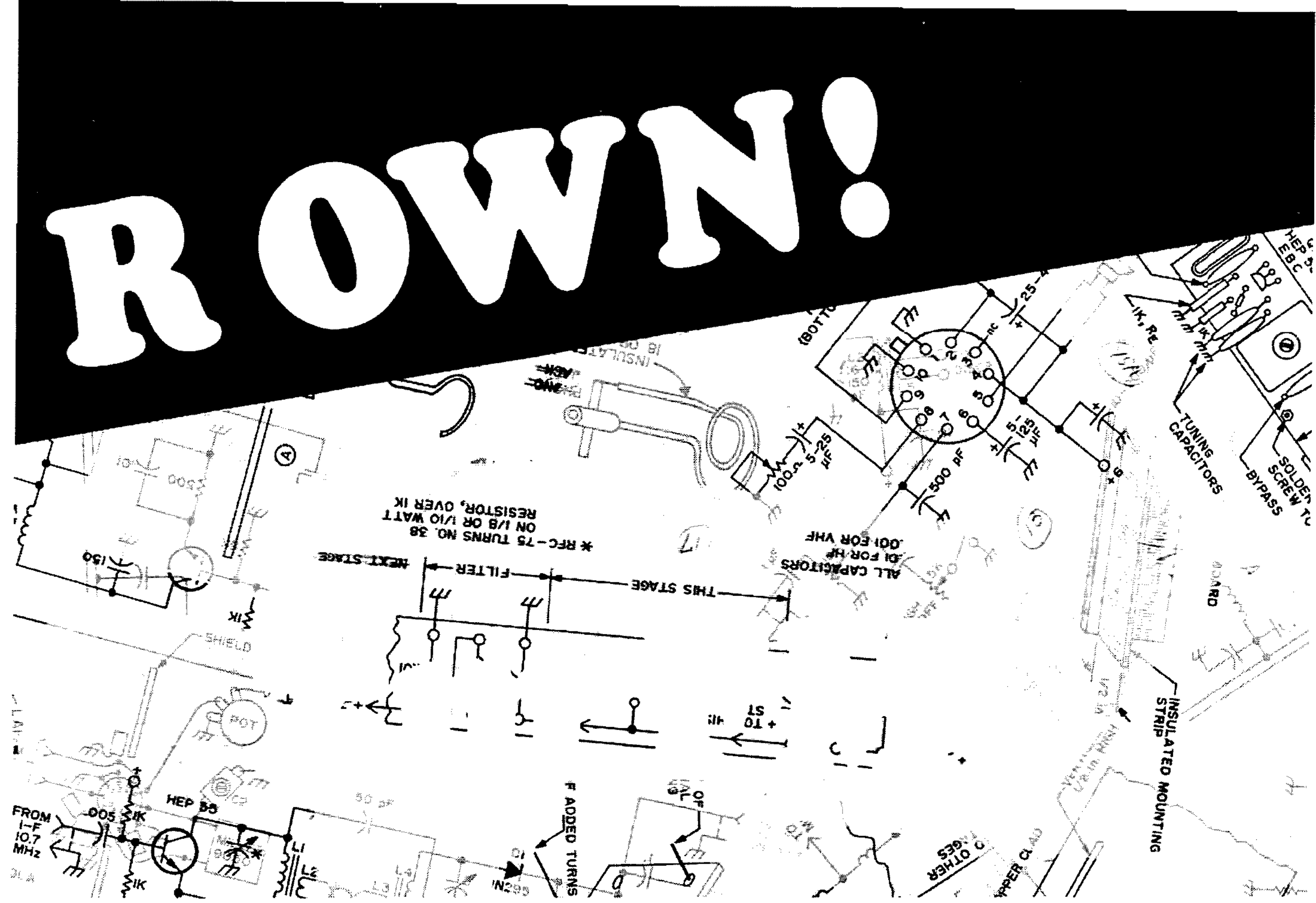
Miniature Components

Capacitors. Bypass units can be the Lafayette thin units (see page 294 of 1970 catalog), where a 0.01 μF job can be found which is only 5/16 in. square by 5/64 in. thick. And the 1000 pF ones are only 11/64 in. square. For the lower values used in coupling and for fixed tuning capacitors, I like the Elmenco dipped silver-mica jobs.

Resistors. Resistors can be the Ohmite ¼ watters, but for the sake of miniaturization, you'll be better off if you get a selection of Allen Bradley 1/8 or 1/10 watt midgets. They're *really* small!

Crystals. The crystals should be the small plug-in kind, about 400 by 175 mils because repeater input channel frequencies do vary across the country. The most prevalent in the U.S. is 146.34, with 146.46 being Canada's prime choice. An absolute must for repeater use is the "Radio Amateur's FM Repeater Handbook," by Ken W. Sessions, Jr., which can be obtained (where else?) at 73.

Coils. The 8 and 24 MHz coils are the 9050 units from J. W. Miller, and are very handy for modifying to suit transistor input impedances, as well as having good, stable, mechanical tuning of the cores.



There isn't much else on the strip that I can see except thin copper-clad, 1/16 in. linen-base Bakelite or fiber glass strips, four Motorola HEP 55s, and two Motorola HEP 75s (2N2866).

Various colors of subminiature wire will help also.

Special Tools

Don't worry about particular tools; they're not too special, as you will see, but you should prepare a little, in order to do a real good job. You must have the usual set of good small tools and it helps to thin down by grinding the already thin needle-nose pliers to get into those really narrow places you will find in back of the mounting strip. Use the same treatment on some small side-cutters also, because you will be cutting off a lot of small wires in even smaller places.

A collection of small low-cost screwdrivers will be handy, too – file them sharp and very small for special places. Sharp-pointed tweezers are handy as well.

For drills I go down to size 65 (35 mils) in a Black and Decker ¼ in. drill with the drill stand for under $10. Depending on how lucky you are, your drill chuck may not take those little drills. Some of them don't. Then you have to lay out another $3 or $4 for a jeweler's chuck, which will take a No. 80 drill (13½ mils).

You do not have to drill the component-lead holes exactly to size but the closer you do the more rigid the parts will be when mounted.

Various fiber TV tuning tools are useful for the trimmer capacitors, and several lengths of ¼ in. Lucite and Bakelite rods make good insulated screwdrivers also.

A slightly unusual aid I employ a lot is a "coffee stick" with an arrowhead-shaped lump of coil wax stuck on the end. When you're winding small coils with small wire it is very handy to put a drop of wax on the coil and let it sink in and cool. You can do this with the tip of your small iron, and it sure helps hold all that tiny wire in place. All the filter chokes shown use this method. Good for a lot of receiver coils to come later, too, and for holding the extra turns wound on the Miller coils for base impedance matching.

Be sure to have plenty of subminiature clip leads with flexible wire of various lengths from 1 in. up to 1 ft.

Have a good selection of Arco midget trimmers on hand also, such as the 400 series, which are just ½ in. long.

No. 48 or 49 bulbs are good for checking rf as you go along the multiplier chain from stage to stage. You should always be able to light one of these, which glow red (dull) at 20 mW. Use a matching series trimmer, as little as 5 pF for 147 MHz and less than 1 pF on 450.

Have a roll of plain masking tape to hold down strips and things while working on them. A small drill vise or the "third hand" bench vise helps, too.

Dos and Don'ts. These hints apply especially to a multiplier chain including a straight-through amplifier used as a phase modulator, which is the circuit being described in this article. It has an 8 MHz crystal oscillator and ends up on 147 MHz, so you must be *sure* of the frequency of each stage as it operates. Do *not*, rely on your receiver or on grid-dipping the inductors first.

These simple and inexpensive test accessories will help you in this work, as I found out – even after 50 years of radio endeavor. I tried rushing this multiplier along without using my homebrew set of absorption wavemeters (see Fig. 1) at every stage and trouble showed up right away.

Getting right down to the point, here is a list of handy items to have on the bench

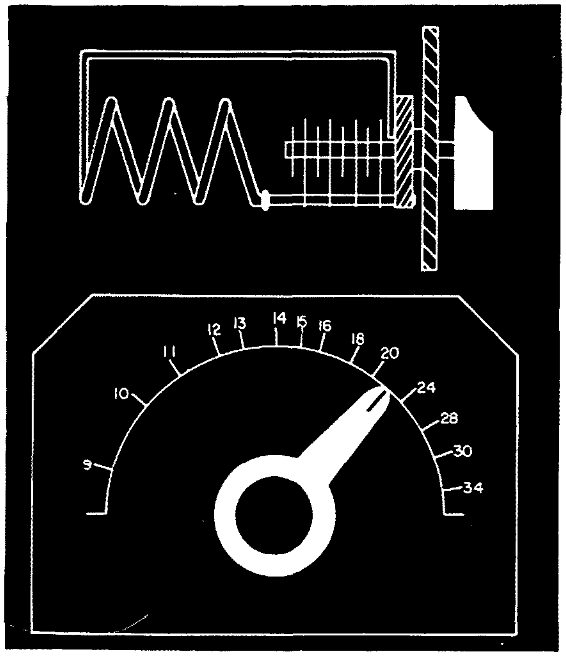


Fig. 1. Typical absorption wavemeter.

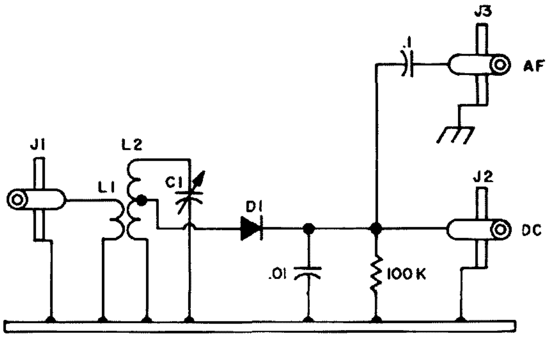


Fig. 2. Tuned diode detector.

while you're building crystal oscillators, phase modulators, multipliers, and amplifiers. Using the absorption wavemeter, any circuit under test can be checked for the real and exact frequency at which it is resonating or oscillating, by lighting a bulb on rf or using a diode detector with a meter. When the absorption meter resonates with the rf in the collector circuit which is lighting the bulb or actuating the meter, a dip in the light or on the meter will show. This indicates the *real* frequency of the main body of the rf present. Some transistor collector circuits not tapped down on coils are especially notorious for this, and may exhibit two frequencies at the same time. For example, there may be energy at 72 and 96 MHz present. This is an indication of mistuning, or overloading, or both. Tap the collector down on the coil, don't load it so heavily to the next stage, check it carefully with the diode meter, and don't worry about a small remnant of off-frequency energy. After all, a multiplier is bound to have some of this present. Just get the *main* amount on frequency and be happy. And be sure the *next* stage also peaks on *its* desired frequency.

A grid-dipper in the *diode* position can also be used for this work. A one-turn link around the low end of the grid-dipper coil and a cable will get you into small places in a rig where you cannot insert the whole dipper.

The diode detector. Figure 2 shows the schematic of one of these useful pieces of equipment which allow you to listen to your transmitter multiplier stage as you build it, and check the actual frequency at the same time. I have a collection of them

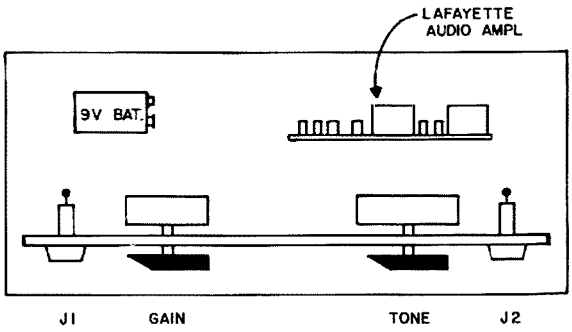


Fig. 3. Handy af assembly, top view

here covering from 125 KHz to 10 GHz. With a good variable capacitor you can generally run over three to one in frequency range – up to the UHF region at least. From there on up things get a little more difficult.

These "receivers," because that's what they really are, although of low sensitivity, are especially helpful in transferring known frequencies on a signal generator to a homemade set of wavemeters.

The meter. This should be as sensitive as possible. Lafayette has good ones down to 50 μA. Use a tap switch to put resistors in series to bring the voltage range up to 10V or so for use with an active portion of the rig such as the 1W final circuit.

The AF Amplifier. This item should not be neglected as it is at times a great aid to getting a trouble-free, *noiseless* carrier, which you can then modulate and be proud of. The valuable RCA handbook, "Transistors, Thyristors, and Diode Manual," has a lot to say about "discontinuous jumps in amplitude or frequency as various levels of drive are encountered." These little termites can be seen on the meter or *heard* on the af amplifier or can show up on both. Figure 3 shows a mounted version of the af amplifier used here for this purpose. It is a worthwhile and handy little piece of equipment to have in a lot of situations, in both receiver tests and transmitter tuneup. Just plug it into J3 of the diode detector in Fig. 2 and hear those unwanted clicks, whistles, rushing noises, squeals, etc., coming from what you may have wishfully thought was good clean rf in your multiplier drive!

Important notice! Overdrive is especially to be avoided in multiplier chains with transistors. Superregeneration is one of the indications. Believe me, it can be a very nasty bug!

Diode detector cable probes. Have a collection of these on hand as in Fig. 4. You can use them also to feed rf into a pilot light, connect up to your lab receiver, etc.

Handy meter jacks. Figure 5 shows an elementary but flexible and useful metering method for checking total or only one stage current.

FOUNDATION RECEIVER

The basic design shown here is for a low-cost single-conversion utility receiver for 2 meter FM; particular attention is given to easy-to-build i-f and discriminator modules for the 10.7 MHz section. The rf is tunable from 144 to 148 MHz, with a switch for AM use. This is a complete portable receiver, *not* tied down to a large ac communications receiver.

Discriminator action, with sample, is shown for easy understanding and homebrewing. Double conversion with crystal control can be added later.

The schematic of Fig. 6 shows how easy it can be. Remember, this is just a basic receiver which, without double-conversion, is a relatively broadband, easy-to-tune job, but it sure pulls in those interesting repeaters!

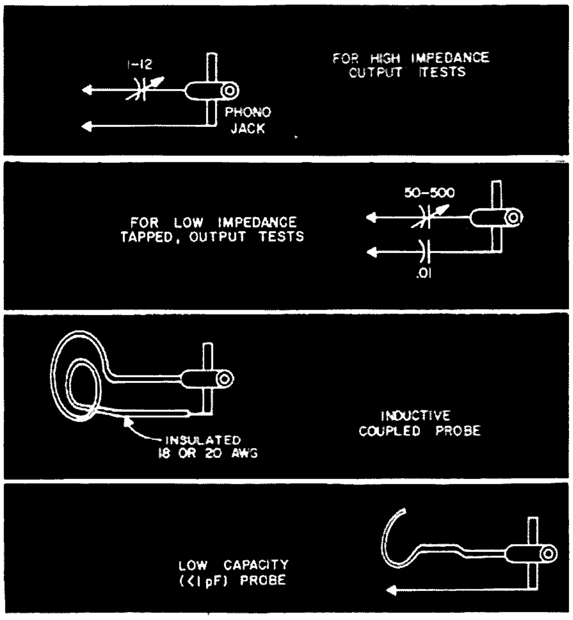


Fig. 4. Coupling methods.

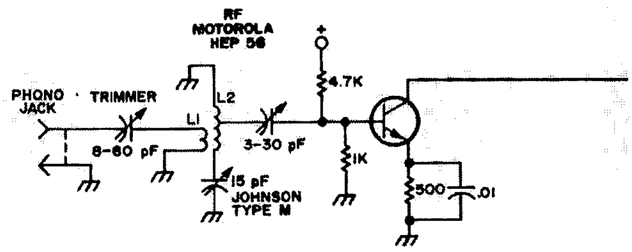
Front End

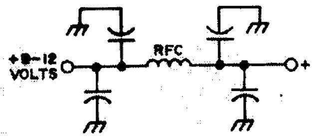
Simplicity is the word in this module. You can check different transistors for low noise, coils for rf, or add a low-noise stage; and the tunable oscillator is easy to change to a crystal oscillator for repeater operation. All three stages are tunable from 144 to 148 for coil, sensitivity, and selectivity experimentation, and to allow you to check the AM section of the band as well as repeater work in your neighborhood.

The oscillator tuning dial also relaxes preliminary oscillator crystal frequency requirements by allowing you to find out what crystals you will want later, and order them without rushing the deal. The link coupling at low impedance permits easy switching from tuned to crystal control, if you wish to retain the tunable feature.

The rf and mixer stages are tuned by small variable capacitors mounted on the baseboard with small brackets made from copper-clad. Small pointer knobs allow peaking of these circuits. The rf stage has a trimmer capacitor feeding the base which is quite useful, resulting in a welcome balance between gain and self-oscillation. The mixer also has a trimmer for its base input, which permits a selectivity adjustment for this circuit.

The tunable oscillator was mounted on the Miller slide-rule dial for mechanical stability as shown in Fig. 7, and works quite well – with the broadband i-f of course. As I write, the repeater band just below 147 MHz is giving out with various repeater-relayed calls, "W1AHE, anybody around?", K1SHE through W1ABI," "W1JLE through WA1KFY," "K6MVH through W1ALE," and various other calls, through such other repeaters as WA1KFZ, K1ZJH, K1MNS, etc.





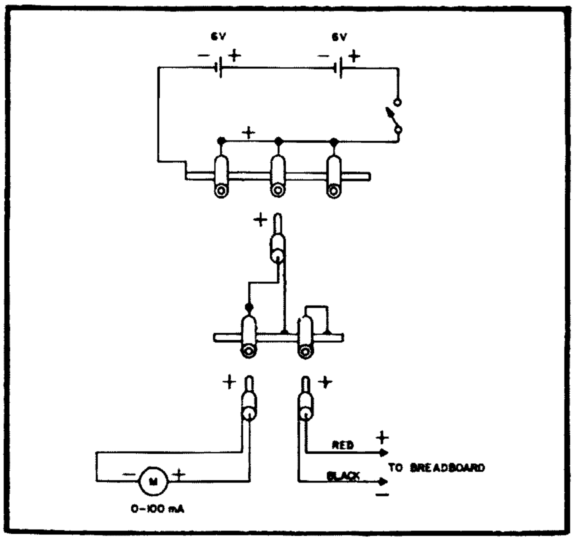


Fig. 5. Handy metering jacks and plugs.

The two-meter band can be spread out from 10 to 90 on the dial by trimming L7, increasing C5, and using a smaller C6.

Oscillator coupling can easily be adjusted for maximum conversion efficiency via L4 and L7, and the cable between them is a good place for the crystal–tunable switch mentioned above. To start up, adjust L7, C5, and C6 for the range 133 to 137.5 MHz as a local oscillator for the i-f of 10.7 MHz to be used later. I tuned up the whole front end using the diode detector of Fig. 2 tuned to 10.7 for the i-f section. When there is lots of 10.7 MHz energy out on L6, such as to deliver 5V dc out of the diode, you've got a good front end!

10.7 MHz I-F Stage

The reliable and sure-fire Motorola HEP 590 IC was used here – 25 dB gain, no

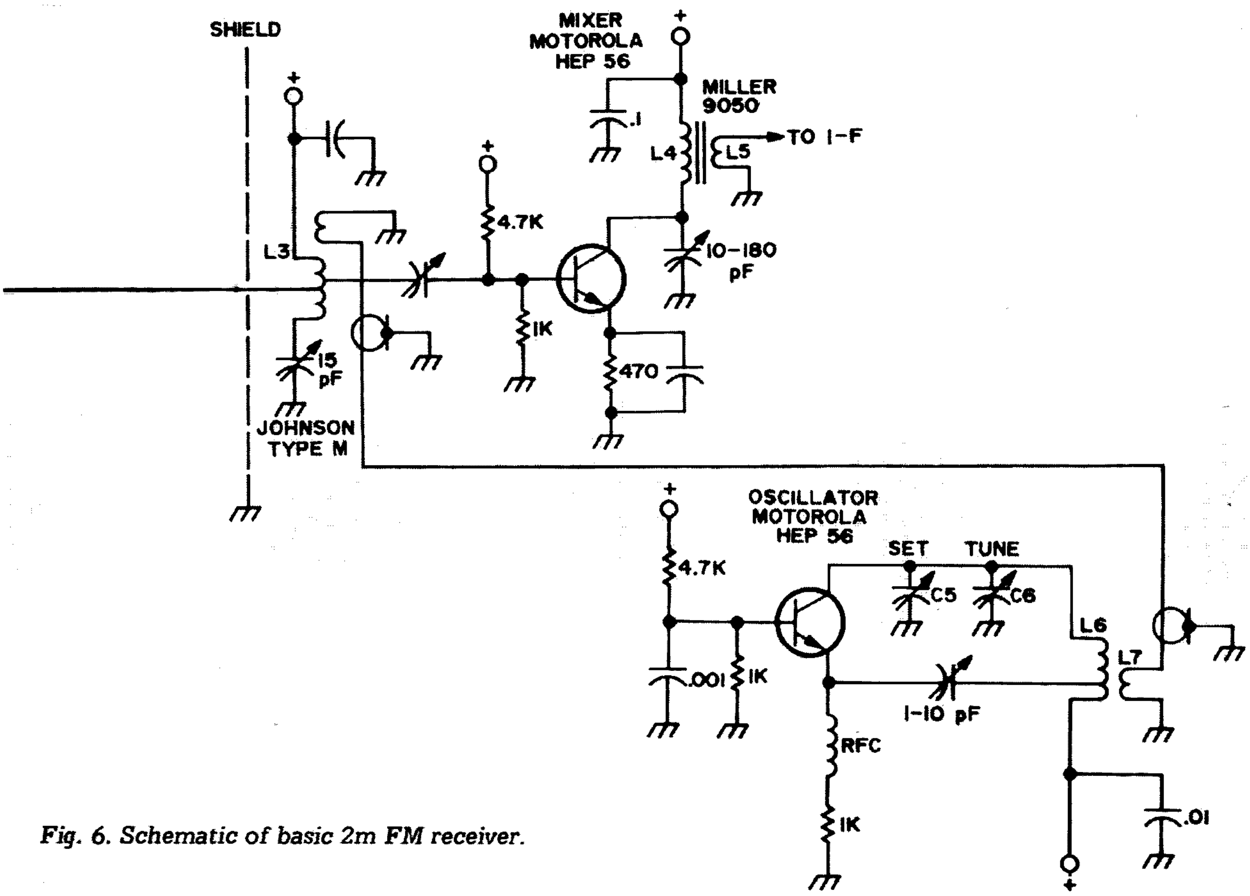


Fig. 6. Schematic of basic 2m FM receiver.

self-oscillation, what else would you use? Figure 8 shows the circuit, using Miller half-inch shielded coils both on the input and output. Note that the 590 is simply turned leads-up and soldered onto a few resistor supports, with a shield, as in Fig. 9. A gain control is used, which may or may not be kept in later as you wish. With the limiters that can be added, the gain control is *not* needed.

A B+ filter is included in each module, and a 100Ω resistor with a 10 μF capacitor may be needed also to cut out motorboating when more stages are added later, if you go to double conversion. Be sure *not* to return L3 to *ground* dc-wise, as the needed bias is supplied internally through pin 4. Pin 9 is the main B+, along with the cold end of L3. Gain control can be obtained through a pot in the pin 5 lead, where maximum gain is reached with pin 5 at *ground* potential.

For new readers, the internal and external circuit of the Motorola IC 590 is shown in Fig. 10. This IC, which is very useful for frequencies up to at least 6 meters, has extremely interesting features, among which can be noted the absence of internal feedback (even at 50 MHz), the high gain, and the excellence of the gain control at pin 5, either manual or automatic. For this receiver, mainly intended for experimental FM use, no avc is used. Later, if you add double conversion, the limiter section module will eliminate the need for avc.

Trimmers are shown for C1 and C2, but fixed capacitors of the proper value may be used to allow tuning of the i-f coils at 10.7 MHz by the variable tuning slug cores in L2 and L3. Note that these Miller half-inch gems have very good electromagnetic as

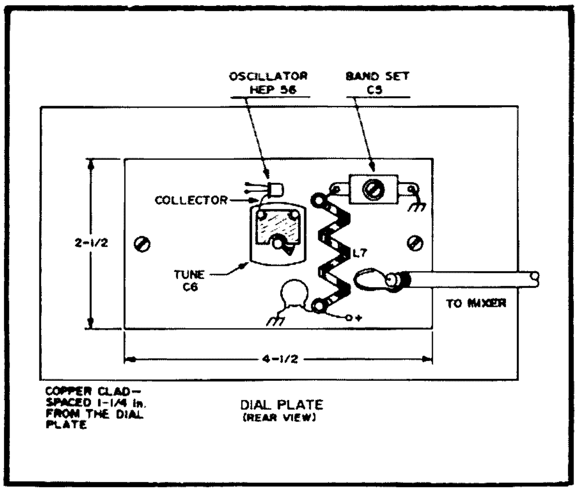


Fig. 7. Dial-mounted local oscillator

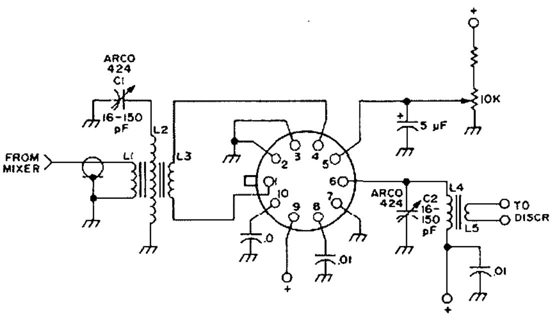


Fig. 8. 10.7 MHz i-f, bottom view of IC.

well as electrostatic shielding, due to the cup-core type of construction, and are available for use from 30 MHz down to 135 kHz.. They can also be easily opened for the addition of primary or secondary low-impedance windings.

Discriminator

After many days on the bench with discriminator circuits I at last hit on one that works like a charm for any frequency tried so far here – at least from 10.7 MHz down to about 135 kHz, and at the same time is easy for the homebrewer to build because of the link coupling. Figure 11 shows the circuit where L1 is a simple tuned coil in the collector circuit, with *no* coupling requirements other than a one- or two-turn link. When the primary of a discriminator transformer has to be coupled just right to the centertapped secondary it is not a job for the usual experimenter at his bench. With the link you can't go wrong. At least I haven't so far. Just tune L1 to 10.7 MHz, put a turn or two around it and another turn on L4 and away you

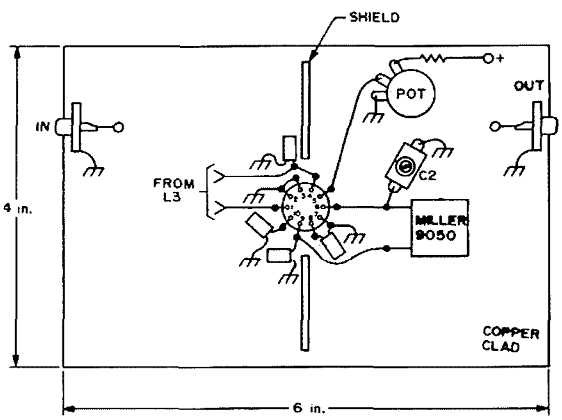


Fig. 9. i-f shielding as seen from top side of board (bottom view of IC).

go. Figure 12 shows the discriminator dc output curve, which handles about 25 kHz for 2-0-2V.

I got the idea of using 10.7 MHz as an i-f (other than the fact that it is used for many years as the i-f for the FM broadcast sets) from some of the little $20 Nagasaki Hardware Co. sets used to pull in the police bands. It is also used a great deal in the two-way mobile sets, no doubt "because it was there" to begin with. It also can be used later as the first i-f, for narrowband work, by adding a 10.7 MHz converter to 455 kHz, and a 455 kHz i-f and discriminator. So, away we went, and I'm having a great time listening to those repeaters. However, please bear in mind that the i-f selectivity at 10.7 MHz is not sufficient for continued use on 2 meters, except to tune up the front end and to get acquainted with what's going on in your neighborhood, even though it is fun! It will also start you off on discriminator work, which I find has some very fascinating aspects, such as the extreme selectivity of the output curve for

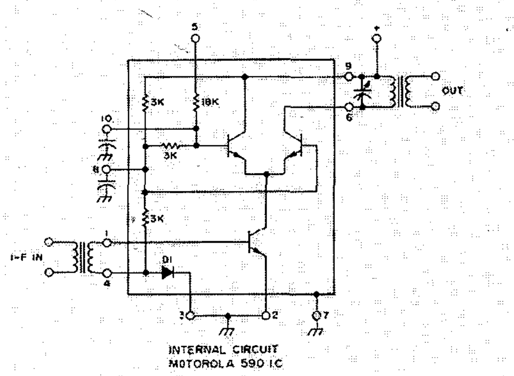
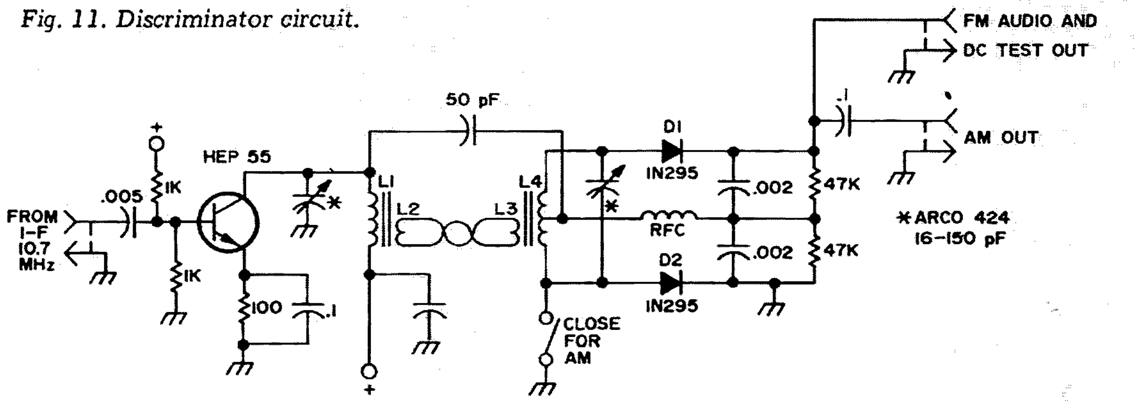


Fig. 10. Internal circuit of Motorola's HEP 590 IC.

one tuned circuit. More later on this if time allows.

Audio Amplification. Just for new readers we'll give a quickie on the Amperex TAA-300 1W "baby-hi-fi" IC which I now use for almost every audio purpose in receivers, and modulators up to a watt. There are about 11 transistors in that one little can, and it is flat to 1 dB from 25 Hz to 25 kHz! Get a halfway decent 8Ω speaker to go with it, because it's worth it. Figure 13 shows how to connect it up.

Fig. 11. Discriminator circuit.



FM TRANSMITTER STRIP

The transmitter section measures 1 in. wide by 8 in. long, and it puts out over a watt on 146–147 MHz, with low-cost components. This miniaturized transmitter is my logical step toward design and ultimate construction of a "shirt pocket" portable transceiver. The parts for that one jump up a little in cost, because it takes a lot more tools to make subminiatures, such as stereo microscopes, special materials and skills, jewelers tools, and so on.

Shape Factor, and Assembly Method.

These are important features, as you will see, allowing the homebrewer to build a complete FM rig in a minibox and still have room enough left over to change components for repairs or design improvements if needed. You can also substitute slightly different components if you have to.

Figure 14 shows the method, using a copper-clad baseboard on which is mounted a drilled ½-in.-high strip of insulating material holding all the components. Bypass capacitor leads to ground are no longer than ¼ in., shielded coils are used, and all tuning is done from one side.

The photos show the happy results of placing the parts to best advantage on such an assembly. Notice that the components are also all on one side, and their leads and connections are on the other side. On the wiring side, every connection is spread out in front of you, with room between each one for good soldering; no resistor supports or other metal tie points are needed.

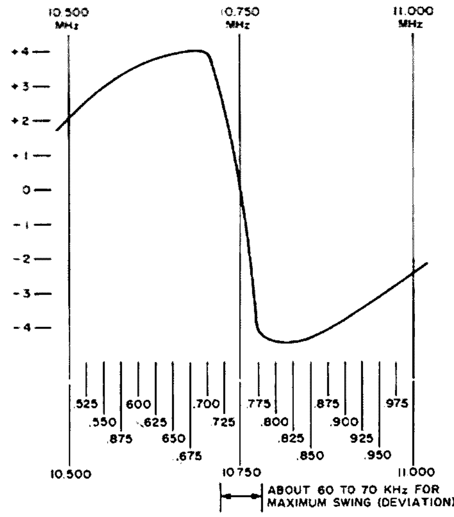


Fig. 12. Discriminator dc output curve.

The B+ lead is red subminiature wire and goes from filter to filter along the strip. The rf lead is green and goes from the coil output tap of each stage to the next base coupling capacitor; the rest of the connections practically fall in place for soldering together. As you can see, there is still room left over!

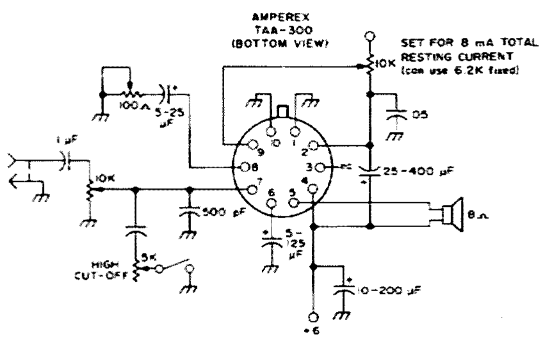
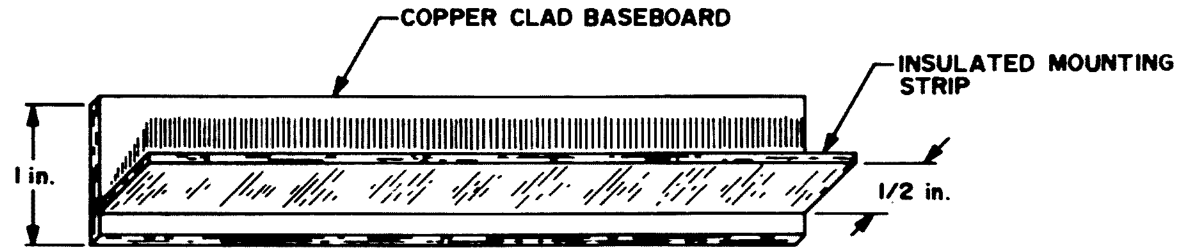


Fig. 13. Audio amplifier IC.

Fig. 14. Baseboard/mounting strip configuration.



The detailed planning of the holes to be drilled becomes a large portion of the work. Figure 15, component side and top views, shows how to start this off. The next step is to make a life-size drilling template using the components you have or intend to use. I mention this because most of these are not critical and you may substitute without trouble providing you keep thinking "little." Even here, you can go bigger with the components if you want to, but your overall package size may expand. You can also go smaller if you plan carefully and cram everything together a little tighter. The reason for this will be evident if you study the circuit, where you will see that no critical wires cross over each other, and that the power amplifier is well away from the oscillator.

Ultimate size is actually up to you, and you can judge for yourself after laying out the parts on hand. If you send for a selection of Lafayette Radio very thin and small capacitors, you will have an easier task to get it down in size.

Figure 16 shows two methods of preliminary fastening of the vertical strip to the copper-clad baseboard. This will start off the assembly, and after the wiring you could hardly tear them apart with your fingers. I counted no less than 25 ground connections to the copper on my own 10 in. strip.

You can also make strip modules of any length you want such as modulator af, receiver sections, etc., as shown in the receiver plans. This makes the task of repairs or improvement changes easier later on. These shorter strips can be fastened end on to each other and fastened down to the baseboard as shown.

Miniature Filters.

Do *not* try to make up frequency multipliers *without* rf filters in the dc line to each stage, unless you care to experiment with rf phasing in battery leads – and that isn't good! (Every time I leave out the filters I get into trouble!) You can make up

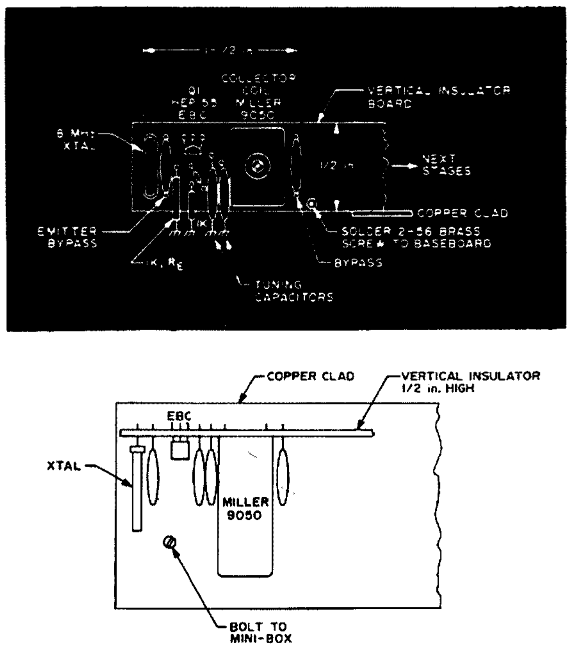


Fig. 15. Component layout, top and side.

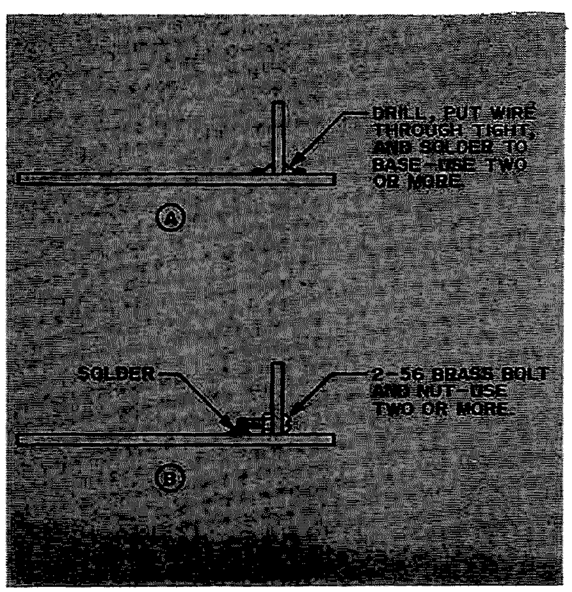


Fig. 16. Methods for fastening insulated strips to baseboard.

"dime" filters without much difficulty if you follow the simple details below. Materials needed are tiny resistors (any value over 1kΩ), some 36 or 38 AWG wire (double silk covered), coil wax (you can use paraffin wax if you can't get coil wax), and small capacitors, such as the Lafayette types. Use 0.01 for HF and 0.001 (1000 pF) for VHF. Figure 17 shows the circuit. The main thing is to interpose an rf trap in the plus lead between each stage and any other.

The series method shown in Fig. 17 is best for high-gain amplifiers because it puts *several* filters between the high-power output stage and the sensitive first stage. However, if the filters are very good you can bring the battery leads from each stage to a common point, but this must be checked carefully if you have to do it.

How to make'em. Clean and tin carefully each resistor form lead close to the body, then melt a thin layer of wax onto the resistor to hold the wire from slipping when you wind it on. Solder one end of the wire onto one lead and then random wind 75 to 100 turns of 38-gage wire onto it, and wrap the end around the other lead ready to solder. Put a drop of wax on the coil before soldering to hold the wire turns in place. The wax should penetrate the whole coil. Most types of insulation on

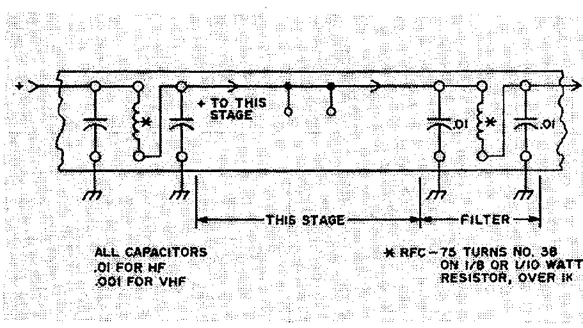


Fig. 17. Miniature filters, interstage.

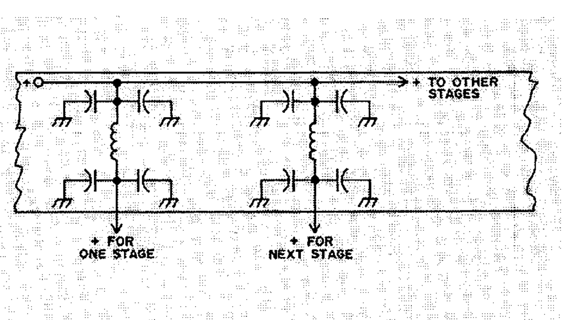


Fig. 18. UHF filters for interstage coupling.

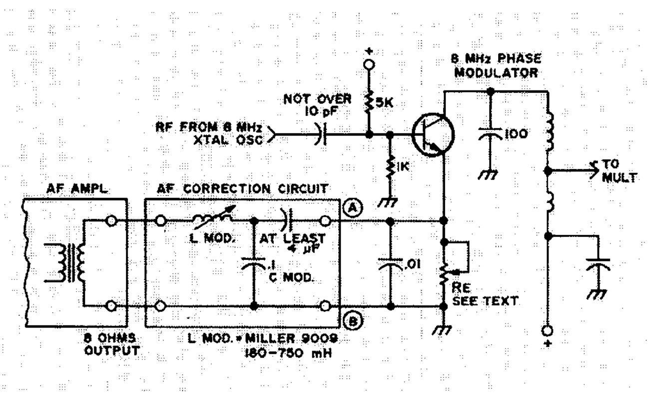


Fig. 19. Phase modulator interconnect circuitry.

38-gage wire will disappear as soon as solder and heat are applied, so you don't have to bare the wire first. Now you have an rf choke, and if you keep the capacitor leads real short to ground, the filter will do the job for you.

It works fine even up to 450 MHz if you use four capacitors, each to different point on the ground plane of copper-clad, as in Fig. 18.

Phase Modulator

Phase modulation results in a type of frequency modulation of the carrier at the rf output jack which the usual FM receiver cannot distinguish from true FM. Being crystal-controlled it is used by practically all the FM mobile and base stations in the U.S. so it is 100% okay here. And of course with the crystals in there, you *will* be on the amateur FM channels, providing you buy them right. You have to pay around $7 for these but it seems well worth it.

Certain designs of the af section of the phase modulator, its tuneup, and the connections to the phase modulator can be troublesome for the homebrewer, so considerable time was spent to make it as simplified and easy to adjust as possible. It also can be used in the receiver section as the af amplifier because the frequency correction is done *outside*. The use of an 8 or 16Ω output connection into the phase modulator emitter circuit helps to stiffen the af drive and keep it clean.

Phase modulation af sections in commercial rigs are often qualified as "audio conditioning," or "processing" circuits, which they are of course, but don't let that bother you. Excellent FM quality can be obtained by the use of an inductance of large value, placed outside of the af amplifier, in the noncritical low-impedance output circuit. The inductance cuts down the extra high audio modulating frequencies caused by the phase modulator's tendency to make the FM deviation directly proportional to the modulating frequency, which emphasizes the highs too much unless corrected. Being outside of the af amplifier, you can now use almost any good low-cost job and use it in the receiver also.

Figure 19 shows the simplicity of the method used. Having a four-transistor amplifer from Lafayette, at $4.95 on hand, that's what was installed, with a slight adjustment of the feedback resistor. This had nothing to do with the FM unit, it just happened that the Lafayette amplifier sounded and acted awful funny at first. And no wonder –, it was oscillating up in the 100 kHz range! After trying to bypass and decouple almost everything in the little brat my eyes began to focus on that printed lead going from the 8Ω output connection over to near the input, and sure enough that was it: too much feedback! An additional 50 kΩ resistor in series with the one already there did the trick and from then on nothing but good af came out. I mention this because it could happen to you too. My 3W job, also Lafayette, is suspect, possibly the same simple trouble.

The af output needed to drive the phase modulator emitter is several hundred millivolts, and the low impedance allows the usual rf bypass capacitor of 10,000 pF to act simply as an additional af filter, which it does.

As a result, the entire tuneup is done by adjusting the value of the emitter resistor and the phase modulator tank tuning coil. Neither are actually critical but should be

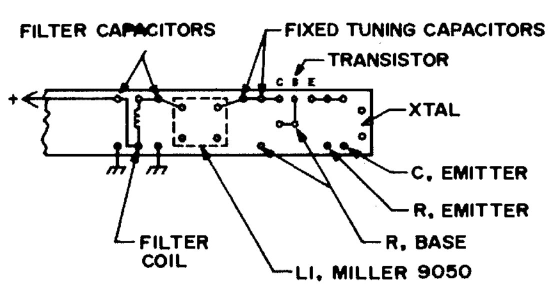


Fig. 20. Drilling layout (wiring side).

adjusted while listening to the 146 MHz carrier on a good amateur narrowband FM receiver. The emitter resistor will be heard to kill the modulation when going much below 2 kΩ and to bring in distortion on large amounts of audio when going a lot more than 2kΩ. This latter condition also causes a drop in the rf output. You may hit it right the first time with the 2kΩ value; I'm just pointing out that this resistor is worth checking up on for a final value when adjusting for best modulation.

The actual phase modulation resulting from varying the emitter voltage with audio is adjusted by tuning, which is also smooth and noncritical. I used the tried-and-true method of listening to my own voice with plenty of audio on the receiver and a set of well-padded earphones (you can get a very useful set for under $10 at Lafayette) which keep your voice from reaching your ears directly through the air. It also cuts down audio feedback.

Tuning with af going into the phase modulator as per Fig. 19, you will notice good strong clean FM on either side of the peak tuning. These points occur *before* the 146 MHz carrier output starts to drop from detuning the phase modulator tank, so don't worry about that part. In any case, you are supposed to be following the phase modulator with enough saturated class C multipliers and amplifiers to prevent any variation in amplitude (otherwise known as AM!) I say "supposed to" because you don't automatically get this condition. You may have noticed an unduly large number of tubes showing in ads for surplus commercial FM sets. This large number is due to the designer's wish to get *all* the benefits of FM into his package. In one box if possible. You have to watch *very* carefully when using ICs for modulators, they tend to pick up rf and generate feedback with their wideband audio circuits and sometimes as many as 11 or even more transistors in one little can. Just a word of what to look out for. It's hit me more than once. Also, don't put more than the specified voltage on IC amps. You can easily drop down with a resistor and a *large* bypass capacitor.

I used my favorite mike on the input, the Astatic 150, my favorite because it only weighs 3 oz, has the most output, −44 dB, costs only $3.82 amateur net, and sounds good!

Almost any desired amount of highs and lows can be obtained or surpressed by the manipulation of the LC values in the modulator. If you use a Miller .9009 wide-range adjustable inductor, 180–750 mH you can hear the difference as you adjust the core in and out.

I started out with a large-scale layout for the parts, but you may wish to skip that and go right to a life-size layout as in Fig. 20. To make the life-size drilling template, lay out the components one after the other, "standing up" on a ½ in. strip of good-grade white cardboard and mark the component lead holes, which should result in something similar to Fig. 20. A nice feature of the cardboard method is the easy punching of the holes and the way it holds the drill as you go through the strip. Tape the template in place onto the insulating vertical strip. Do not use anything that melts under heat, though. Even if you ruin part of the strip, or want to make a large change of one stage you can just saw that out and make up another section and go ahead.

The 8 MHz Oscillator

Figure 21 shows the schematic of the crystal oscillator stage. Note the apparent use of negative feedback with the base return through the crystal to a tap on the inductance. It is only apparent though, as the crystal reverses the feedback phase, making it positive. It is a very powerful, sure-fire circuit.

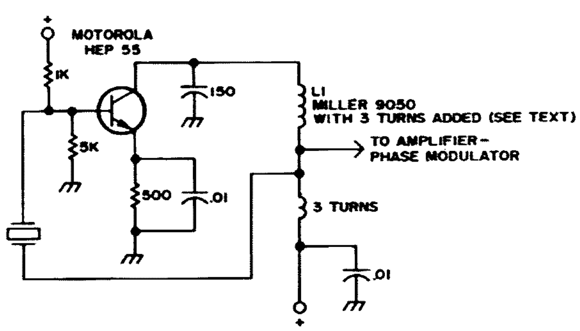


Fig. 21. 8 MHz oscillator schematic.

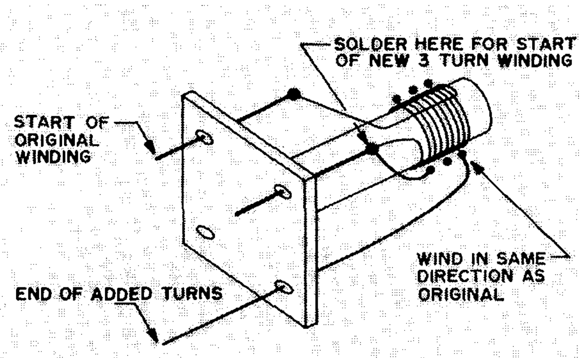


Fig. 22. Miller 9050 coil with added turns.

The tap on the coil also provides a good low-impedance match for the next base input. The coil itself is made from a Miller 9050 shielded coil which has magnetic as well as electrostatic shielding, and a good adjustable core that works good mechanically (which is more than you can say for some of those types of cores).

Remove the aluminum can by bending back the four holding tabs and wind on three turns of 30- or 32-gage silk-covered wire onto the existing winding of the coil. Be sure and wind them in the same direction as the turns that are already there. The oscillator coil will then look like Fig. 22, and is ready to mount on the strip.

The wiring on the lead side of the strip is shown in Fig. 23, where most of the leads are seen to fall in place quite well.

Insert the component leads through the strip and bend them slightly in the direction they will go, such as the two base resistor leads which are bent towards the base lead, as shown clearly in Fig. 23. When all the leads to be soldered in one place are all touching each other, a final dressing can be done followed by soldering. In the example mentioned, the base lead has three other wires soldered to it, a wire from the crystal, the 1 kΩ resistor, and the 5 kΩ resistor.

The can of the 9050 coil has a tab which should be soldered to ground. The ground lead of some resistors (or all of them) is not routed through the strip but is soldered to the baseboard on the component side of the strip.

When the oscillator is assembled and wired, B+ can be brought in and the unit tested for rf. Some 5–10 mA of current

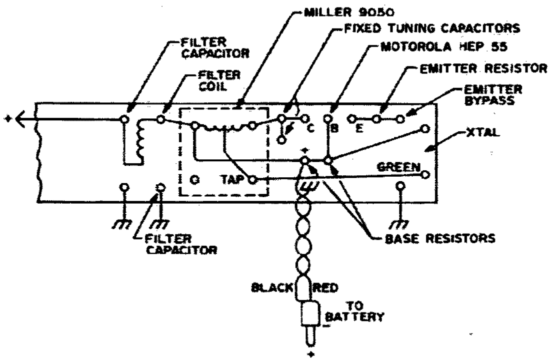


Fig. 23. Oscillator wiring diagram (lead side of strip).

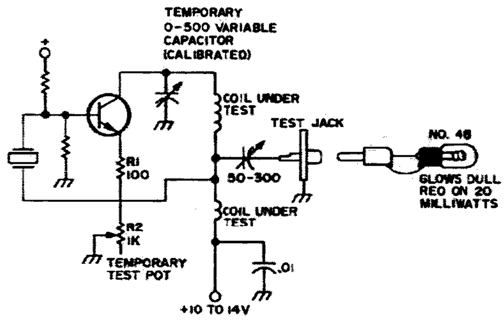


Fig. 24. Oscillator test setup.

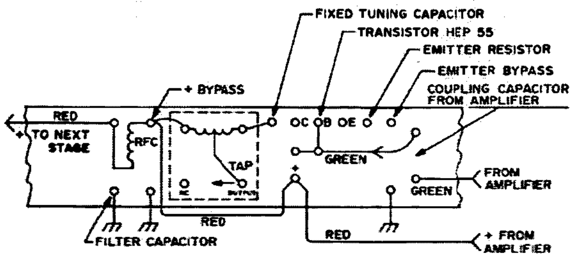


Fig. 27. Wiring diagram, 8 MHz tripler.

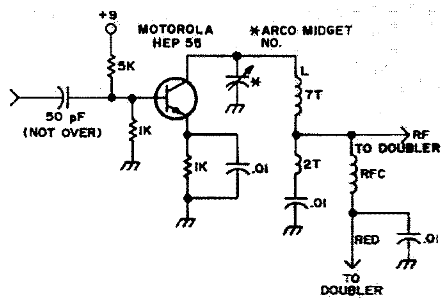


Fig. 28. 24 MHz tripler schematic.

should register and as soon as the oscillator coil is resonated to the crystal frequency, the oscillator should show rf output to the 8 MHz tuned diode test set connected to the output tap lead.

Check the oscillator carefully on a sharp receiver for its frequency-holding ability while tuning the slug in and out of resonance at 8 MHz. Actually this will be near 8.130 MHz. (With a multiplication of X18, this should land on whatever 2 meter FM channel you're aiming for). It should come into resonance on one side with a good "plop" and gradually build up on the other side as you tune.

I always start with a large calibrated variable capacity at C3 (some 500 or 1000 pF, made from an old BC set three-ganger) and then put in fixed values so that the iron core tuning slug in the 9050 coil tunes properly about ½ in. under the winding of the coil.

Power can be adjusted by the emitter resistor, and feedback by the number of turns between ground and the oscillator-coil tap. (These are of course the number of turns added to the Miller 9050.)

A 48 or 49 bulb, rated at 2V and 60mA, should light up with about 50 to 100 mW worth of rf with a 50–300 pF trimmer in series, as in Fig. 24. When the oscillator is properly tuned and under good power control via the test pot (in Fig. 24) and the plus voltage is checked for the voltages you expect to see, the next stage can be assembled. Of course if you wish, you can mark out the whole strip template, drill all the holes, and mount and solder all components except the coupling capacitor and B+ to the next stage. This allows you to test the oscillator by itself.

The 8 MHz Amplifier–Phase Modulator

This stage (Fig. 25) is not critical, other than to keep the input base coupling capacitor at a low value to avoid self-oscillation. The only requirement is that the tuning should be correct for phase modulation.

Use the same methods of assembly, wiring, and tuneup for power output as with the oscillator stage. You do not need much gain, if any, in this stage.

The 8–24 MHz Tripler Stage

A frequency multiplier has the advantage that generally (though not always) it is

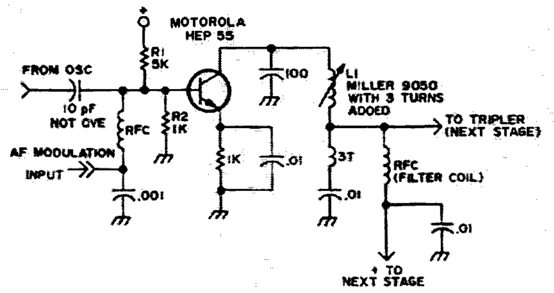


Fig. 25. Schematic of phase modulator/amplifier.

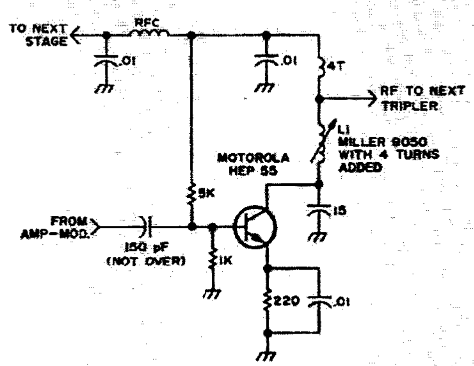


Fig. 26. 8 MHz tripler schematic.

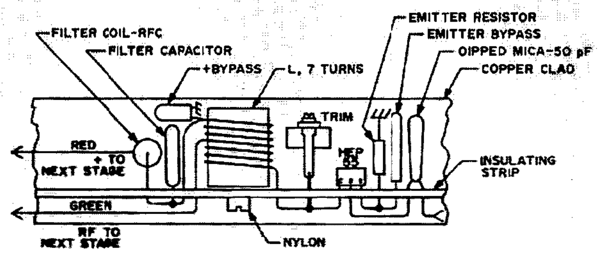


Fig. 29. 24 MHz tripler wiring diagram.

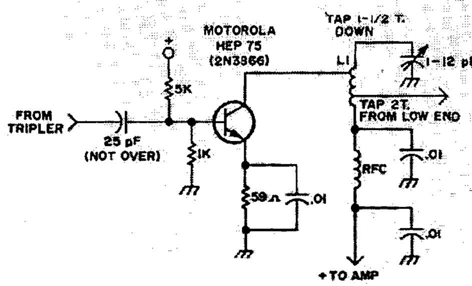


Fig. 30. 73 MHz doubler schematic

free from self-oscillation, due mainly to the output and input circuits being on different frequencies. The bias requirements are different in a tripler from those of a doubler or class C straight-through amplifier, but this can be adjusted simply by varying the emitter resistor during tuneup for maximum output on the desired frequency. Figure 26 shows the schematic of this stage, where the base input coupling capacitor is seen to be much larger than in the preceding stage. However, in spite of a small tap winding and low impedance in the preceding stage it is easy to cause superregeneration in the base circuit if the coupling capacitor is too large. I found that 150 pF or slightly less is a good value.

The wiring side layout for this stage, which is typical of the multiplier circuits, is shown in Fig. 27. A logical wiring system is seen to prevail, especially as regards the emitter, base, and collector wiring and their components. Two extra wires are used, one red for the B+ and one green for the base input rf circuits, with a filter coil separating the plus of each stage.

A 24 MHz diode detector is clipped onto the rf output tap on the inductor (Fig. 27), as was done in the preceding stages. Be very *sure* you're on 24 MHz, and not on 16 or 32. Here again you should be able to light a 48 bulb with rf with a 5–180 pF trimmer in series for matching. The collector tuning and power output curve with emitter resistor lowering should be clean and smooth.

As mentioned in the test equipment section, it is a real *must* to *listen* to the carrier as you build it up in frequency. I do this with a little af amplifier continually connected to the diode detector output because the carrier has to be free of all spurious noise, squeals, frequency and power jumps, etc.

The Tripler to 73 MHz

This one proceeds in a similar fashion to the previous stage, except that now we begin to use capacitor tuning of the collector coils. The iron-core coils of the Miller 9050 series do not do a good job here, and so far I have not found good ones at reasonable cost, so you have to wind your own but that is very easy, as you will see.

Figure 28 shows the circuit and values obtained by tests here. Do not exceed the

value of 50 pF for the base input capacitor. In case of any spurious noise, this is the first place to look; in fact, I always start off with a trimmer at that point to make sure and get the maximum drive possible *without* noise.

When the stage is assembled and wired and under test as done with the previous stages, once again, look out for those *undesired* harmonics, especially the 64 MHz one in this case. It'll sneak up on you if you're not real careful!

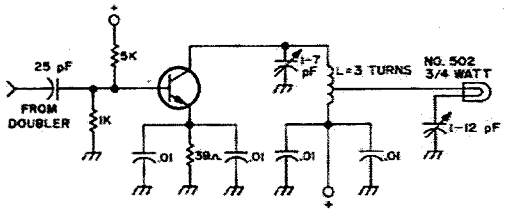


Fig. 31. 146 MHz amplifier schematic.

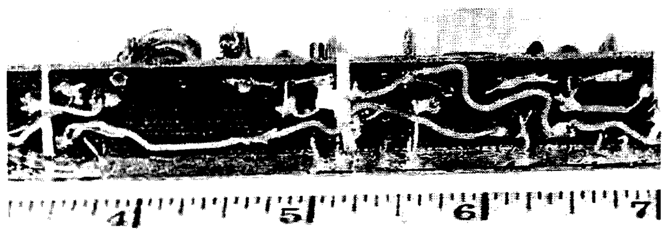
The inductor may be fastened to the mounting strip with a nylon screw (Fig. 29) for ruggedness. The variable capacitor does all right standing up on end with the fixed plates soldered to the baseboard, and the movable plates brought out through the strip with a piece of 16- or 18-gage wire, where it is joined up with the collector, as can be plainly seen in Fig. 29.

Clip on your diode detector for power checks and frequency. You can't check this latter too often, believe me. After testing for power control and noise, you are ready for the next stage, a doubler.

The Doubler to 146 MHz

This stage uses a Motorola HEP 75 (2N3866), always a lively powerful one for VHF. The schematic, shown in Fig. 30, is quite similar to the others except for the different transistor and another coil tap. The base input capacitor worked out at 25 pF maximum, with a 39Ω emitter resistor to keep the power up for maximum input into the final stage. The collector lead is cut off and the collector connection is made by soldering a 1/8-in.-wide soft and thin copper strap, which increases the heat-sinking as well as rf conduction, directly to the HEP 75 case.

Clean the case well by scraping at the place to be soldered. Use small solder, a



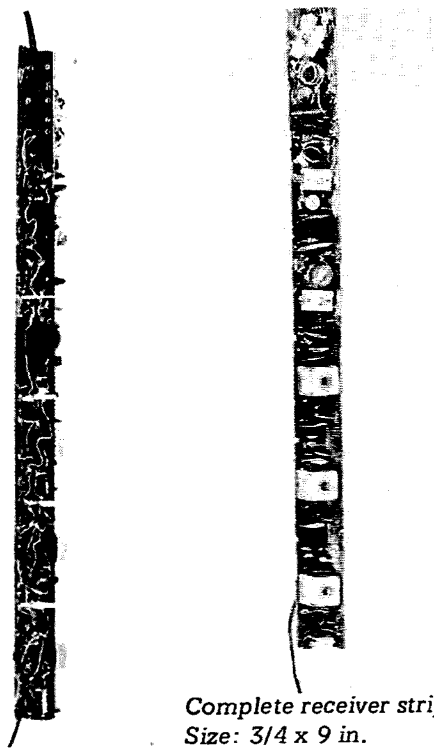
Closeup of wiring side of insulated strip.

small iron, rub the iron gently on the case two or three times for about one second only to effect a good joint for the collector strap over to the coil. The inductance is not actually critical but should be correctly tuned up and tapped for the collector as well as the output tap. After all you *do* need all the power you can get into that final.

You could use a little larger emitter resistor, for a little less current, but here again power is a point to watch. I find about 50 to 120 mW of rf at 146 MHz at the output tap, depending on the plus voltage also. Of course, you can play around with up to 18V if you want to push out a bigger signal. Before buttoning up this stage, check it once more for frequency, please.

Power Amplifier

Refer to Fig. 31. Everything went along nicely with this one also, as in the previous



Complete receiver strip. Size: 3/4 x 9 in.

stage. You will note a nice feature, true of most electronic circuits that are good and foolproof, that when everything is tuned up correctly and matched properly the whole stage becomes less critical all around. That is, the tuning is not touchy, the power goes up and down nicely, and even the output tap is not too critical. Note that with small emitter resistors of under 50Ω the collector current can get pretty high, so always keep at least 10Ω in series, as you test for the best emitter resistor value. Don't forget that 1W is 100 mA at 10V. And for a watt out you will need more than 100 mW even at 15V. "Big" transmitters (50 watters) use as low as 0.1Ω at times in this place, and in some of the new heat-sunk jobs (out of our price range) the emitter goes directly to ground.

I suggest currents of not over 100 mA for this stage. The arrangement shown uses about 50 to 60 mA, depending on drive from the tripler, B+ voltage, and output loading.

Two bypass capacitors are used in the collector circuit. A test bulb (5V at 150 mA), in series with a 1–12 pF trimmer to ground, indicates rf output and loads the collector circuit. Without the test bulb or any antenna loading you can expect self-oscillation as the HEP 75 gives plenty of action on 146 MHz. The output tap can be led into the small but good and very useful 50Ω cable (RG-174/U). This cable will then go to your changeover switch or relay for the final assembly.

As a final note on the transmitter, each tuned circuit of the multipliers and finals should also be adjusted while listening to the carrier modulation. I didn't find any of these at all critical but "the books" say to do this to assure absence of phase-shift distortion in circuits after the phase modulator.

So, good luck with PM, it doesn't seem too tough to build if you avoid the fancy stuff to start with. ...K1CLL■

All Motorola ICs for this project are available from Circuit Specialists Co., Box 3047, Scottsdale AZ 85257.

Blowup view shows degree of miniaturization

REPEATER DIRECTORY

A Directory of Open VHF/UHF Repeaters in the U.S. and Canada

An up-to-date listing of open repeaters from coast to coast, with information on range, access requirements, and other operating data. Additions, deletions, and changes should be addressed to 73 Magazine, Repeater Directory, Peterborough NH 03458.

AMERICAN REPEATERS (OPEN)

Listings in this directory are alphabetical by state, area of coverage. This concept (as opposed to a listing by actual repeater location) allows mobile operators to determine with ease the repeaters available for use along any cross-country route.

ALABAMA
- W4RFR (wideband) 146.34 146.94
- W4VO (NE ALA, NW GA) 146.34 146.94
- K4SPP (Green Mt) 146.94 147.54
- K41QU (Huntsville) 146.34 146.94
- WB4QEX (Birmingham) 146.34 146.94
  BARES. No tones. 60W. 3dB gain antennas. Input/output coverage well-matched. Autopatch.
- No call (Albertville) 146.34 146.94
- WB4QEV (Mobile) 146.34 146.94
  Mobile Co. CD. Open access; 24-hr coverage. 200 ft. 6 dB gain antennas. Autopatch under way. 50W output.

ALASKA
- Anchorage 146.34 146.94
- Nome 146.34 146.96

ARIZONA
Prescott
- W7AJU (wideband) 146.34 146.94

Phoenix and surrounding area
  Arizona Rptr Assn., 30 mi. range. 60W. Eleve: 2000 ft.
- WA7CEM (wideband) 146.34 146.94
- 146.16 146.76
- 449.30 445.30
- K7VOR 146.94 146.28

Sierra Vista
- WA7KYT (wideband) 146.34 146.94
  Cochise AR FM Assn.

Tucson
- K7PQI 146.34 146.94

ARKANSAS
- W5DI (Little Rock) narrowband) 146.34 146.94
  Central Arkansas Radio Emergency Net

CALIFORNIA
Alameda County
- K6SWS 146.34 146.94
  1800 Hz tone
- WB6QEO 147.00 146.34
  1950 Hz tone

Butte County
- WCECE 147.00 146.49

Contra Costa County
- WB6AAE 146.20 196.80
- 449.50 444.50
  (Alameda, Santa Clara, San Francisco, Sacramento, Contra Costa, San Mateo) Carrier Squelch; 1800 ft height. 80W.
- WB6AAE 449.50 444.50
  (Same as above) 2.4 kHz tone burst required in event of intermod. Also interconnected to .94 remote base (1950 Hz).
- W6CX (Mt. Diablo ARC) 147.80 147.06

El Dorado County
- K4TXK/6 .... 146.07 147.54

Fresno County
- WB6HYL, 2100 Hz 146.34 146.20
- WB6HYL 146.80 146.20
- W6JPU 448.00 449.93
- 146.12 147.71
- 51.725 51.125
- 146.85 147.71

Inyo County
- WA6TTL 146.34 146.94

Humbolt County
- WB6DGJ 146.34 146.94

Kern County
- WA6UJK 145.155 146.90

Los Angeles
- WA6TIC (RTTY) 146.58 52.60
- W6FNO Special jammer: 146.58 146.70
- W6FNO (Radio Ranch) 146.82 146.70
  Wideband. Transmissions limited by timer to 1 min. Covers San Fernando Valley, San Gabriel Valley, Pomona Valley, Paradise Valley, most of Los Angeles County, Orange County, parts of Riverside County and southern third of San Bernardino County. Elevation: 3000 ft; separate Tx and Tx sites; 350W out. User must whistle to activate initially; carrier-operated unless input channel vacated for 3 min.
- WA6NUD (Cerritos AR League) 146.34 146.94
- WB6TXX 224.82 221.70
- WB6VYX 224.82 146.70

Extended Southern California
- WA6UJS (Southern Calif.) 52.76 52.525
- 52.525 449.95
  Three receiver locations: Sunset Ridge, Mt. Lukens, and Santiago Peak. Transmitter: Mt. Wilson. 450 MHz links interconnect system elements. Base stations should listen to 449.95 talkback for possible simplex traffic on 52.525. Transmitter output power is 500W.
- WB6ZDI (Culver City). Palisades ARC 146.61 147.33
  7 a.m. to midnite. No tone.
- WB6GUA (Palmdale area) 146.34 146.94
  1800 Hz

Marin County
- K6GWE 146.10 146.70
- K6GEWE 448.25 443.25
- No Call (San Pablo Pump Soc.) 146.40 145.47

Mariposa County
- WB6EMJ 146.06 146.76

Monterey County
- K6LY (Naval Postgrad School Club) 146.37 146.97

Nevada County
- WA6UGS (Grass Valley Rptr.) 146.34 146.94
  2250 Hz

Placer County
- WB6QVV 51.60 51.00
  1800 Hz tone burst

Sacramento County
- WA6RYO (No tone required) 146.80 146.20

San Luis Obispo County
- WB6TSO (Cuesta Peak) 146.20 146.80

San Mateo County
- WA6TSM (So. Peninsula ARC) 146.13 146.73
- 448.45 443.45
- K6QFO (RACES) 147.31 145.49AM
- WA6BTH 51.90 51.35

San Bernardino County
- WA6UGQ (Controlled per request from UHF) 146.34 146.46
- 146.34 146.94

San Diego County
- WB6WLV 146.34 146.85

Santa Clara County
- WB6OQS (SC Vly UHF Rptr. Soc.) 146.16 146.76
- 449.60 444.60
- 146.68AM 146.76
- WB6LJR (Pacific Commun. Soc.) 51.624 51.024
- 449.80 444.80
  1950 Hz tone burst
- WA6UFE (Pacific Telco Empl.) 146.04 146.52

WA6YCZ (Bay Area Commun. Soc.) . . 146.85 147.71
. . . . . . 449.93 448.00
. . . . . . UHF 146.34
W6DOO (Mt. Alison) 146.85 147.71
. . . . . . UHF 146.34
Santa Cruz County
K6JGE 146.928 147.60
Solano County
WB6WYI (No. Cal. ARSI 51.60 51.0
2100 Hz tone burst
W6AEX (Soc. of Amat. Operators) . . . 144.20 147.85
WA6UGY (Mt. Vaca RC) 114.34 146.94
. . . . . . 146.49 147.00
W6GDD (on call) 146.34 146.94
Sonoma County
WB6SXC 145.98 146.90
Tulare County
WB60PG 145.22 146.88
2200 Hz tone burst
WB60PG 145.62 146.76
1800 Hz tone burst
WB6OPH 51.236 52.80

CANADA

Nova Scotia
VE1ARC (Halifax) 146.46 146.94
VE1JD (Sydney) 146.46 146.94
VE1KI (St. John, N.B.) 146.46 146.94
VE1VHF (Moncton) 146.46 146.94
VE1XK (Truro) 146.46 146.94
Newfoundland
VO1GT (Covers all of Cape) 146.46 146.94
Quebec
VE2AT (Mt. Carmel) wideband 146.46 146.94
VE2CAT (Montreal) 146.18 146.64
VE2CLA (Montreal) 146.10 147.30
VE2CRA (Ottawa) 146.46 146.94
. . . . . . 443.30 146.94
. . . . . . 146.94 448.30
VE2CRS (Chicoutimi) 146.46 146.94
VE2ES (Matane) 146.46 146.94
. . . . . . 146.34 146.94
VE2FZ (Sherbrooke) 146.46 146.94
VE2JE (Drummondville) 146.46 146.94
VE2JE (Eastern Montreal) 146.52 147.50
VE2JE (Riviere du Loup) 146.46 146.94
VE2MT (Mt. Royal, Montoreal) 146.46 146.94
. . . . . . 146.46 147.06
VE2OM (Mt. Belair) wideband 146.46 146.94
VE2RM (Montreal and westward) 147.40 147.18
VE2PY (Montreal) 146.28 146.88
VE2TA (Mt. Orford; P.Q. & 146.52 147.50
northern Vt.
VE2VD (southern Quebec) 146.52 147.50
VE2VD (Quebec City) 146.52 147.50
VE2XW (Mt. St. Bruno; Montreal & vic. 146.70 147.60
VE2ZO (Montreal) 146.46 147.06

Ontario
VE3BSQ (Kingston) 146.46 146.94
VE3DRW(Hamiton) 146.16 146.76
VE3KBR 146.46 146.94
VE3KSR (Kitchener/Stratford) 146.34 146.94
VE3LCR (Grimsby) 146.52 147.42
VE3MOT (Toronto) 146.58 147.18
VE3NRS (Niagara Falls) 146.22 147.24
VE3OSH (Oshawa) 146.40 147.12
VE3PBO(Peterboro) 146.34 146.94
VE3RPT (Toronto & extended area) . . 146.46 147.06
VE3SIX (St. Catherine) 146.22 147.24
VESSM (Sault Ste.Marie; coverage 146.34 146.94
includes N WI)
VE3SSS (Toronto) 146.64 147.30
VE3STP (Ottawa) 146.34 147.06
Manitoba
VE4XK (Winnipeg and extended area . 146.46 146.94
in southern regions of Province
Saskatchewan
VE5SS (Regina) 146.46 147.33
Alberta
VE6OL (Grand Prairie) 146.46 147.00
Wideband. 60W. 100 mi. range
VE6AUY (Calgary) 146.46 147.00
VE6WQ (Edmonton) 146.46 147.33

British Columbia
VE7ACS (Vancouver) 146.34 146.94
VE7AFG (Prince George) 146.58 147.33
VE7BEL (wideband) 146.22 147.54
VE7BTU (Nelson) 146.46 147.33
VE7CAP (Kimberley) 146.46 147.33
VE7ELK (Chilliwack) 147.33 146.58
No tone; wideband

COLORADO

Pueblo
WAØSNO (wideband) 146.34 146.94
Colorado Springs 146.34 146.94
(Cheyenne Mt.; wideband)
WØPXZ (Glad Park; wideband) 145.32 146.94
60 mi. radius average, 7100 ft.
WØPRZ (Grand Junction; wideband) . . 145.32 146.94
32 mi. radius average, 4800 ft.
WØIA (Boulder; narrowband) 146.16 146.76
1800 Hz tone burst
8100 ft. Rocky Mt. VHF Soc. (Covers Denver, Cheyenne, northeast state).
UHF facility: 444.55 449.55
WØWYX (Denver; narrowband) 146.34 146.94
Tone burst
WØWYX (Denver) UHF facility 444.45 449.45
Rocky Mtn. Relay League. 11,500 ft
No call (Denver Radio Club UHF) 444.35 449.35

CONNECTICUT

WA1KEK (Bridgeport) 146.22 146.76
Multistate coverage. CARS repeater, 24-hr operation, tape-logged. 325 ft elevation for receiver gain antenna. Transmit antenna is groundplane at 200 ft. Approximately 400W out.
WA1JTB (Trumbull) 146.31 146.88
WA1KGD (Bethany, 750 ft; 146.11 146.61
narrowband)
Covers Stamford to Madison, Hartford to Long Island, N.Y. 80W. (New Haven County Amateur Rptr. Assn. Lts.)
No call yet (Avon Mountain) 146.28 146.94
W1BNF (narrowband) 146.37 146.98
Southern Massachusetts and Eastern Long Island, N.Y., plus much of Connecticut.
No call yet (proposed ARRL repeater; . 146.22 146.76
Newington, CT)
K1IIG (Hartford) 146.28 146.88
W1VVK (Avon) 146.34 146.94
. . . . . . 146.94 52.92
South to New Haven and East Long Island, north to Greenfield.
K1ZJH (Covers most of state 146.34 146.94
from Holyoke, Mass.
WA1KFZ (Covers north part of state . . 146.04 146.91
from central Mass.)
Addl. rptr. planned for .34/.94.
WA1KFX (Mt. Snow, Vermont) 146.31 146.88
WA1DMX (Vernon) 146.25 146.82
No tone; autopatch. Pioneer Valley Rptr. Assn.

DELAWARE

WA3DZD (Baltimore) 146.34 146.76
. . . . . . 52.525 146.82

FLORIDA

Northern Florida
No call given (Starke; narrowband) . . . 146.34 146.94
Central Florida
WB4HAE (Tampa; narrow) 146.34 146.76
WB4QEN (Tampa) 444.1 449.1
WB4GLK (Okeechobee; east central . . . 146.34 146.94
area; narrowband)
WB4GLK (Same) 146.94 146.76
W4IKB (Chipley) 146.34 146.94
W4GGU (Panama City) 146.34 146.76
Northwest Florida
WB4KLT (Ft. Walton Beach) 146.34 146.76
Whistle-on
Whistle-on, 1800 Hz narrowband. Split site. Receiver: Destin, Florida. Transmitter: Ft. Walton Beach. Maximum directivity, rcvr: north. Antennas approximately 40 miles. Uplink, downlink, and controls via

450 MHz. Autopatch. After ID, system shuts down and requires new tone for reactivation.
WA4EVU (Ft. Walton Beach; wideband) 146.34 146.76
WB4KNQ (Brevard Rptr. Assn.) 146.34 146.76
60W; 150 ft height; gain antenna.
Narrowband. Touchtone control via UHF link.
W4UC (Pensacola & vicinity; wideband) 146.34 146.76
2.2 kHz tone; 5 Flags ARS
Southern Florida
WB4HAA (Miami; no tones; narrowband) 146.34 146.76
(Southern Florida FM Assn.) From University of Miami, covers from Pompano Beach to Florida City. Receiver equipped with preamp. 100W transmitter. Touchtone autopatch.

GEORGIA
W4BOC (Decatur) 146.34 146.76
No call (Augusta) 146.34 146.94
WB4NST (Atlanta) 146.34 146.76
PRIVATE REPEATER; TRANSIENTS REPORTEDLY UNWELCOME
W4VO N.W. GA Area
(2100 Hz) 146.34 146.94
(no tone) 146.46 146.94
.... 449.475 449.85

HAWAII
KH6EQF (Diamond Head; narrowband; 146.20 146.80
linked to other EQF systems) ... 147.00AM 146.80
.... 52.525 53.520
KH6EQK (Mt. Holeakala; narrowband) 146.34 146.94
.... 146.20 146.80
KH6EQL (Waialua; narrowband) 146.20 146.80
All Hawaii repeaters operated and maintained by Honolulu Emergency ARC.
KH6NLH (Waipahu) 146.16 146.76
KH6EQR (Lualualei) 146.34 146.94

IDAHO
K7ZZL (Deer Pt) 146.34 146.94
Boise Valley Repeater, 7000 ft elev. Open. Wideband.

ILLINOIS
Northern Illinois
WA9WVA (Batavia) 147.66 146.58
.... 146.04 146.58
No tone. N. Ill. ARC.
10 sec. dropout relay.
WA9EAW (Aurora) 45 mi. range 147.40 147.81
Autora FM Amateur Radio Assn.
W9FBS 146.82 146.94
WA9LIV (Waukegan) (wideband) 146.34 146.76
1950 Hz tone burst
W9BYZ/9 (Genoa) 146.34 146.76
1650 Hz tone
Central Illinois
No call (Rockford) 146.82 146.94
WA9GCK (Bloomington) 146.22 146.94
WA9EAM (Petersburg) 146.34 146.94
WA9EAT (Joliet) 146.28 146.98
WA9WVB (Chamgagne/Urbana) 147.48 147.18
Chicago and vicinity
WA9ORC (Chicago FM Club) 146.34 146.76
Tone access - 1800 Hz North Receiver
2000 Hz South Receiver
60W transmitter at First National Bank Building, Chicago, Illinois. Antenna height 880 ft ERP - 200W.
Six meters: Tone access - 1800 Hz.
60W transmitter in downtown Chicago. Antenna height 500 ft. ERP - 120W.
450 System
Carrier access (open repeater)
10W transmitter at First National Bank Building, Chicago, Illinos. Antenna height 880 ft. ERP - 20W.
Logic voting system under construction to accommodate 8 receiver sites for 1 meter system. Timer limits transmissions to 2 min. Coverage includes Waukegan, La Porte, Indiana, Wheaton, Chicago Heights.
WA9DZ 52.76 52.525
.... 52.76 52.64

WA9EAE (City) 146.46 146.64
WA9EAE (lower city) 146.46 146.88
.... 52.76 52.525
300 ft high, separate sites ..... 147.50 (Base only)
W9NGI (SRO CFAR) (Mobiles) 147.45 147.75
No tone (Bases) 147.50 147.75

INDIANA
Anderson
WA9WVC (Madison County) 146.34 146.76
Open daily 5 p.m. (Narrowband)
Fort Wayne
W9INX 146.46 146.88
Allen Co. Technical Society.
Narrowband; 250W.
.... 52.64 52.88
.... 448.80 444.444
WA9EAU (Fort Wayne Rptr. Assn.) ... 146.34 146.76
Narrowband; no tone. 250W transmitter at 310 ft; receiver at 550 ft. 45 mi. radius. Phone patch.
Schererville
W9EHZ (Midwest Rptr. Assn.) 146.34 146.91
WB9ADO Split site. 146.40 146.91
Secondary freq: 146.34 146.76
Indianapolis
WA9HRK 146.46 146.88
K9LEH 146.34 146.76
Muncie
(No call) 146.34 146.94

IOWA
Clinton area
K9ITW 146.34 146.94
WA8PUD 146.34 146.94
KØIXR 146.34 146.94
Polk Co. Rptr. Assn. Narrowband. Whistle-on (1.2–1.3 kHz). Timer-limited to 2.5 min. 90 ft. antennas. 50W out. 30 mi. radius of coverage.

KANSAS
Southeast Kansas
WØDKU (Wichita) 146.34 146.94
WØIPB 146.34 146.94
Wideband repeater with autopatch. Covers south-eastern and south central portion of state. Input continuously monitored.
WØIPB 146.22 146.82
Wideband repeater similar in design, construction, and coverage to that of WØDKU.
Topeka area
WAØSNP (wideband) 146.34 146.94
Northeast Kansas
WAØOFH (KC) (wideband) 146.34 146.94
WAØOFH (KC) (wideband) 52.70 2.525
Central Kanses
WAØCJQ (Salina) 146.34 146.94

KENTUCKY
W4MOP (Louisville) 146.34 146.94
K4UCS (Ownesboro) 146.34 146.94

LOUISIANA
New Orleans Area
W5UK 146.34 146.94
Whistle-on. 1.8 kHz tone to start, then COR until 10 sec after squelch fail. Narrowband. New Orleans VHF Club.
Baton Rouge
WA5ZHD (narrowband) No tone 146.34 146.94
Alexandria
WA5MZZ (narrowband) No tone 146.34 146.94
Lake Charles
W5WN (narrowband) No tone 146.34 146.94
Monroe
W5GQZ (narrowband) No tone 52.827 52.525
Antenna height 1000 ft.

MAINE
W1GZS (Sanford) 146.13 146.73
Touchtone linked to KIMNS, Derry N.H.

MARYLAND

Baltimore

WA3DZD 146.34 146.76
WA3DZD 146.22 146.82
WA3DZD 448.10 449.10

Silver Spring

WA3CJD 52.76 52.565
W3JCN 448.00 449.00

MASSACHUSETTS

K1ZJH (Covers most of state) 146.34 146.94
WA1KFY (Marlboro) 146.22 146.82
.......................146.34 146.82
Tone burst entry: 1.8 kHz
WA1KFY 52.525 146.82
WA1KFY 146.22 52.525
852 Hz on 1.8 kHz tone
Full digital/touchtone autopatch. Three-minute phone call limit by timer. Repeaters interconnect at will with W1ALE and K1ZJH.
WA1KFX (Mt. Snow VT) 146.31 146.88
WA1KFZ (No. Adams) 146.04 146.91
K1MNS (Derry NH) 146.25 146.76
.......................444.25 447.25
Covers northeastern Massachusetts
W1ABI (Killington) 146.28 146.88
2400 Hz 146.28 146.94
1800 Hz 146.34 146.88
2400 Hz 146.34 146.94
W1VAK (Cape Cod) 146.34 146.94
WA1KGM (Mt. Ascutney) 146.16 146.76
W1ALE 146.34 146.94
Operates .34–.94, except every 15 min., when it converts to 146.46/146.94 and 52.525/146.94. (God knows why.)
W1WAK (New Bedford) 146.34 146.94
W1BL (Princeton) 53.54 50.50
WA1KGL (Woburn) 146.28 146.88
K1ABR (Providence RI) 146.10 146.70
No call (Lenox Mountain) 146.25 146.76
.......................146.25 146.94
No call (Williamstown) 146.34 146.94
K1IRH (Cape Code) 146.34 146.94
Springfield 440.65 447.65
Springfield 440.70 447.70
W1DPD (Cambridge)...............146.34 146.94

MICHIGAN

Benton Harbor

K8JKI 146.34 146.76

Grand Rapids

WA8AAT supplied info: 146.34 146.94

Lansing

No call given 146.34 146.94

Oshtemo

K8TIW (24-hr operation) 146.34 146.94

Detroit area

WA8BDD (Clarkston) 146.34 146.76
Serves southeast Michigan. (No tone req.)
WB8CQS 146.34 146.76
(Includes 450 MHz links from Trenton, Grosse Pointe, and Farmington. No tone req.)
K8VLN (Detroit Area Rptr. Team; 146.46 146.64
narrowband)
70W transmitter, gain antennas. Transmitter height: 275 ft; Receiver height: 435 ft. No tones required.

Pontiac-Rochester

No call given 146.46 146.94

Kalamazoo

K8TIW 146.34 146.94

MINNESOTA

Twin Cities (St. Paul; Minneaplis)

WØPZT (Mobile Amateur Radio Corps .146.34 146.46
of Hennepin County)
WØCKF 146.94 146.46
.......................53.64 146.46
.......................146.94 53.64
Talklock system; priority input is .34; courtesy input is .94. No tones req; 24-hour operation. Deviation: compromise (±10 kHz)
No call given (Elk River) 146.34 146.94

MISSISSIPPI

K5TYP (Keesler AFB) 146.34 146.94
Serves Biloxi and area from Alabama to Bay St. Louis. 2.0 kHz tone burst. Narrow/wide.
WA5UEG (Bay St. Louis) 146.34 146.94
Covers Gulf Coast from Louisiana border to Gulfport, Mississipi. 1.8 kHz whistle-on. Narrowband.
W5UK (New Orleans; narrow/wide) ...146.34 146.94
2.2 kHz whistle-on. 40 mi. radius.
WA5RMS (Gautier)
2400 Hz 146.34 146.94

MISSOURI

Kansas City

WAØOFH (KC, Mo. and Kansas) 146.34 146.94
WAØOFH (KC, Mo. and Kansas) 52.70 52.525
KØOKI 52.88 52.525
WAØVVB (KC, Mo. and east) 146.34 146.94
KØFRA (occasionally) 52.70 52.525
WAØAMR (full-time; open)..........146.16 146.76

St. Louis

WAØCJW 146.34 146.94

St. Louis area

KØRWU (Chesterfield) Narrow........52.05 51.25
Wide 441.56 449.56

MONTANA

Butte, Anaconda

No call given 146.34 146.94

NEBRASKA

Omaha

WØEQU (Ak-Sar-Ben RC) 146.34 146.94

Lincoln

WAØMFC......................146.34 146.94

NEVADA

K7UGT (Reno) Sierra New ARS 146.34 146.94
2400 Hz tone burst
COR 146.94 147.48
W7AKE (Las Vegas) (9000 ft.) 146.20 146.80
.......................147.18 147.84
.......................147.18 51.525
.......................52.525 147.84
.......................52.525 53.275
K7UGE (Las Vegas) 146.34 146.94
146.20 input has priority over 147.18 and 52.525 inputs. 146.34 input is intermittent only; energized on request and on special occasions. All repeaters are open.
WA7NHV ((Capable of crosslink) 146.34 146.49
.......................147.00 146.94
WA7HXO (Las Vegas Rptr. Assn.) 146.40 146.94
No call given (Elk River) 146.34 146.94

NEW HAMPSHIRE (See also listings for Mass.)

W1ALE (Concord) 146.34 146.94
.......................146.34 146.94
.......................52.525 146.94
.......................146.94 52.525
.......................146.46 146.94
Covers south and central portions of state, plus northeast portion of Massachusetts. Operates .34–.94 except every 15 minutes, when it operates .46–.94 and 52.525-A4 for 3 minutes.
K1MNS (Derry) 146.25 146.76
.......................444.25 447.25
Covers southern and southeast portions of state plus northeast edge of Massachusetts.
WA1KFX (Mt. Snow) 146.31 146.88
Covers Vermont, south central, and southwest New Hampshire, plus northwest Massachusetts.
1800 Hz 146.31 146.94
1950 Hz 146.34 146.94
2250 Hz 146.34 146.88
WA1KFZ (N. Adams, Mass.) 146.04 146.91
K1ZJH (Mt. Tom, Mass.) 146.04 146.94
Covers southwest New Hampshire plus western areas of Massachusetts
Soon to change input to 146.40 .. (146.40) 146.94
W1ABI (Killington, Vermont)
2400 Hz 146.28 146.94
1800 Hz 146.34 146.88
2400 Hz 146.34 146.94
(See complete list under N.Y.)

WA1KGM (Mt. Ascutney) 146.16 146.76
Covers northeastern Vermont FM Repeater Association.
2100 Hz tone burst 146.34 141.94
1800 Hz tone burst 146.34 146.88
K6MVH/1 (Peterborough) 146.34 146.94
W2NSD/1 (Pack Monadnock) 146.37 146.73
W1KOO (Mt. Mansfield, Vermont) 146.34 146.94
.... 146.37 146.94
Covers central and northern areas of New Hampshire, Vermont and northeast New York.
K1ABR (Providence, R. I.) 146.10 146.70
No call (Woonsocket, R. I.) 146.10 146.70

NEW JERSEY
WA2UWR (Paramus) 146.28 146.79
PL activates repeater, which then operates on a carrier-operated basis. Control cycle limits – 3 min. Covers northern New Jersey and New York City. Wideband in, compromise out.
WA2UWR (UHF repeater) 449.10 448.10
W2CVT 146.37 146.76
Call unknown (Ford, N.J.) 146.28 146.76
Provides coverage throughout northern regions of state.
Call unknown (Brunswick) 146.34 146.94
Provides coverage throughout state.
WA2UWC (Greenbrook) 146.58 146.94
Electr. Technol. Society Repeater. According to WB2CTD repeater is 34 in. Other reports indicate 58 in.
K2ODP (Entire state) 146.22 146.82
WA2UWO 146.70 52.64
.... 52.56 146.76
According to WB2CTD, this repeater is not open; according to WB2AEB, it *is* open, but with PL burst because of interference.

NEW MEXICO
Albuquerque
WA5JDZ (Mt. Taylor) 146.34 146.94
Narrowband; autopatch. No tone required. Covers upper third of state. 11,350 ft elev.
WA5VKY (Sandia Crest) 146.46 147.06
Narrowband; autopatch. No tones. 10,600 ft elev.
K5FSB (Sandia Crest) Narrowband. ... 448.60 443.60
WA5OIP (Under construction) 146.25 146.88
WA5QXB (Under construction) 146.40 147.00
Los Alamos
W5PDO Narrowband; autopatch 146.34 146.94
Alamogordo
WA5KUI (Alamo Pk) Narrowband. ... 146.34 146.94
9800 ft. elev.
Central N.M.
WA5YTK (Sierra Blanca) Narrowband. 145.50 146.50
11,200 ft elev.
Portales
WA5YTG 146.34 146.94
Las Cruces
(No call) 146.34 146.94
.... 146.46 147.06
Soon to move delete primary operating frequencies.
Roswell
WA5DMQ (Capitan Summit) 146.34 146.94
10,200 ft elev.

NEW YORK
Long Island (All narrowband)
K2HOI (whistle-on) 146.34 146.76
WA2UYI (PL: 107.1, 151.4, 162.2 Hz) 441.75 446.75
W2OQI (Manorville; 2588 tone burst) . 146.34 146.82
.... 146.52 146.76
W1BNF (Connecticut; narrowband) ... 147.37 146.98
WA2UWC (Greenbrook, New Jersey) .. 146.58 146.94
No call given 52.8 146.76
No call given 441.60 446.60
LIFMA 441.75 446.75
K1TKJ 146.25 146.73
No call given 441.85 446.85
LIMARC 146.34 146.76
No call given (Woodmere, L.I. NY) ... 146.41 146.64
W2DEG (Grafton) 146.22 146.76
WA2KEC (Experimental) 146.34 146.94
Moving to 146.55/146.82 soon.
.... 146.34 52.72
.... 52.80 52.72
K1TKJ/2 (New York City) 146.19 146.73
No call (Gore Mt.) Proposed 441.0 446.0
No call (Belfry Mt.) Proposed 441.1 446.1
No call (Old Field Pt.) Proposed 441.2 446.2
WA2UWT (Cuba) 146.34 146.94
Mt. Chaos Amateur Repeater Club.
WA2UWQ (Rochester) 146.28 146.88
Rochester Radio Repeater Assn. Solid-state, 25W.
No call given (Whiteface Mt.) N.A.R.A. 146.22 146.76
W2CVT (Mt. Beacon) locals only 146.34 146.76
Extended coverage 146.37 146.76
Northeast New York
WB2NNZ (Troy) 53.75 52.58
.... 146.34 146.94
K2AE 146.40 52.525
K2AE 146.46 146.94
K2GVI (Utica-Rome) 146.34 146.94
W2CVT (Mt. Beacon) 146.37 146.76
W2GHR 146.13 146.73
W2AWX 441.10 449.1
Call Pending 441.15 446.15
(NW FM Rptr. Assn.)
Syracuse
WA2UWF 146.46 146.94
.... 53.75 52.64
W1ABI (Killington, Vermont) Tone 52.92 146.94
Tone 52.92 146.88
Tone 52.92 146.70
Tone 146.28 146.88
Tone 146.34 146.88
1800 Hz Tone 146.34 146.88
2100 Hz Tone 146.34 146.94
TTY 52.92 146.70
Staten Island
WA2YYQ (Narrowband) 146.25 146.88
TTY 146.10 146.70
TTY 146.25 146.70
.... 146.37 146.88
Whiteface Mountain
WA2UYJ 146.22 146.82
.... 441.35 446.35
Buffalo
K2GUG 146.34 146.94
WB2TLJ 146.34 146.94
.... 146.31 146.91
Lockport
K2ECQ 146.25 146.82
W1KOO (Mt. Mansfield, Vt.) 146.37 146.94
WA2UWC (Greenbrook, NJ) 146.58 146.94
WA2UWR (N.J. repeater) 146.28 146.79
Requires 4A PL tone.
Other repeaters serving New York:
WA2UWO (N.J.)
W2CVT (Conn.)
K1TKJ (Conn.)
WB2NNZ (N.J.)
WA2UYP (Mt. Beacon) 441.55 446.55
Hempstead VHF Soc.
Transitional signaling channel 446.45

NORTH CAROLINA
North Central area
WA4FYS (Burlington) 52.76 52.525
Has secondary output on 146.98
Western area
W4WID (Lenoir) 52.76 52.525
W4DCD (N. Wilkesboro) 52.525 146.90
W4DCD 52.78 52.525
WB4PPS (Roaring Gap) 146.22 146.94
No tones. 10.5 dB gain antennas. 20W system. Elevation is 2914 ft. Coverage: 100 miles plus. (Secondary of cross-connected system)
W4BFB (Charlotte) 146.34 146.94
WA4VTX (Elizabeth City; 146.28 146.88
narrowband)
200 ft 50W, 50 mi. radius
No call given (Durham) 146.34 146.94

K4HXD (Knoxville, TN) 146.34 146.94
.... 146.38 146.94
146.38 has priority.
Wide in, compromise out.
K41TL (Raleigh) 146.34 146.76
W4DCD (Wilkesboro) 146.42 52.525
.... 52.525 146.42
.... 52.78 52.525

OHIO
WB8C RV (Cleveland) 146.28 146.88
According to K8IDT, the repeater-frequencies have changed from .88/.40 to those shown here. *FM Hy-banders, Inc.*
No call (Columbus) 146.34 146.76
K8PWL (Fairfield Co.) 146.22 146.88
Users requested to announce time data and repeater call.
W8AIC (Delaware/Westerville) 146.34 146.76
Users requested to announce time for tape log. Three-minute timeout.
W8QLS 146.62 146.97
WB8CQK (Dayton) Untoned 146.34 146.76
1250 Hz 146.34 146.94
Base stations: 146.28 146.82
WB8CQO (Toledo) 146.34 146.76
60W transmitter; 50 mi. radius
W8IOO (Youngstown; narrowband) ... 146.34 146.76
K8EUR (Ashtabula)
Coverage radius: 30 mi., 350W. Plans to raise antennas in near future.
Mobiles 146.34 146.76
bases 146.25 146.76
WB8CRS (Cincinnati) 146.34 146.94
1800 Hz tone burst
K8JHG (Ottawa) 52.76 52.525
Secondary system operates on 53.36/53.54. Uses gain antennas, low power. No tones required.
.... 146.28 146.88
WA8PLZ (Miamisburg) 146.22 146.82

OKLAHOMA
Oklahoma City
WA5ONI 146.34 146.96
(Mid-Oklahoma Repeater, Inc.)
1477 Hz (center frequency) whistle-on system. Touchtone activates with numerals 3, 6, 9, or #. After tone actuation, repeater is carrier operated until 30 seconds elapses without signal input. Output deviation is ±8 kHz. Contains links on secondary repeater channels in the 220 and 450 MHz bands. ERP: 2 kW.
Enid
WA5QYE (500W) 146.34 146.94
Bartlesville
WA5LDJ 52.525 146.94
.... 146.34 146.94
Ponca City
No call 146.34 146.94
Chickasha
W5MQA (Sentry Crystals) 146.34 146.94
.... 449.45 444.45
.... 146.37 146.97
Ardmore
No call 146.34 146.94
Durant
No call 146.34 146.94
Cherokee
No call 146.94FM 145.96AM
Central/Eastern Oklahoma ......
WA5LVT (Tulsa) 146.34 146.94
.... 52.68 52.525
The repeater has its main transmitter at the National Bank of Tulsa Building with a satellite transmitter just installed at Bartlesville, Oklahoma operated by K5YZO. Main transmitter output is 450 watts. Satellite transmitter power is 15 watts. The system receives on 3 remote receivers located around the area. The highest receiver site is on the Channel 6 TV tower north of Sand Springs, Oklahoma.
WA5KWH (Tulsa) 146.22 146.82
Touchtone controlled; # sign activates. Whistle-on planned.

OREGON
Portland
K7DVK 447.17 449.17
K7UGN 146.76 146.58
According to some readers, this repeater should be deleted, but W7DVR reports the repeater still operational.
W7DBS (Eugene) 146.34 146.94
W7VS (Portland) 146.76 146.58
No call given (Newport) 146.76 146.94
No call given (Dalles; Mt. Livingston) ... 53.46 52.92
No call given (Pendleton) 146.34 146.76
No call given (LaGrande) 146.34 146.76
W7OFY (Medford) 146.34 146.94

PENNSYLVANIA
WA3IPP (Sellersville) 146.28 146.76
.... 146.34 146.76
WA3KUR (Philadelphia) 52.76 52.525
WA3KUR (Philadelphia) 52.76 52.64
WA3BKO 146.22 146.82
(Philadelphia intercity repeater)
WA3IGS 52.80 52.72
.... 146.28 146.76
Baltimore 146.22 146.82
WA3BKO (Harrisburg-York) 146.22 146.82
WA3ICC (Harrisburg) 146.34 146.76
K3PQZ (York) 146.34 146.76
WA3KUW (State College) 146.34 146.76
No call given 146.40 146.40
(Sayreville)
K3ZTP (Coatsville) 146.22 146.82
K3UQD (Pittsburgh) 146.34 146.94
Alternate: 146.34 146.76

RHODE ISLAND
K1ABR (Providence; 146.10 146.70
narrowband)
Rhode Island coverage also available from active repeaters in neighboring states.
(Woonsocket; narrowband) 146.10 146.70

SOUTH CAROLINA
WB5PLN (Columbia) 52.76 52.525
.... 146.34 146.94
60-70 miles radius. Central portion of state.
WA4SSJ (Greenville) 52.76 52.525
WB4BLN (Columbia) 146.34 146.94
.... 52.76 52.525
Split-site system. Open; carrier-operated. 50 mi radius of coverage.

TENNESSEE
Nashville
W4AY (narrowband) 146.10 146.64
W4RFR (wideband) 146.34 146.94
WB4QEY (narrowband) 146.04 147.18
Covers north-central Tenn. Autopatch with 2805 Hz Secode. Repeater on Music Mountain, near Gallatin. Link frequencies on 450 MHz.
WA4YND (narrowband) 146.70 147.70
WB4EKI (narrowband) 146.04 147.18
Chattanooga
WB4KLO 146.34 146.94
Tape voice ID at 3 min. internvals. Chat. Tri-State FM Assn.
Shelbyville
W4IWV 146.94 146.94
Memphis
W4CV 146.34 146.94
Knoxville area
K4HXD (Walland) 146.38 146.94
.... 146.34 146.94
146.38 input has priority. Also covers portions of N.C.

TEXAS

San Antonio
WA5UNH (Wide in, semi-wide out)S.A.R.O. 146.34 146.94

Dalls (No calls given) 53.55 52.95
146.22 146.82
146.34 146.94
52.85 52.95
High power; duplexer. Operated by Regional Emergency Communications Assn.

Northeast Texas
WA5LDL (Tyler; narrowband) 146.34 146.94
230 ft high. 30W. Operates 6 a.m. to 12 midnight.
No call given (Fort Worth) 53.05 53.15
WA5YTM (Fort Worth) 146.34 146.94
146.16 146.76
338.90 449.10
Texas VHF-FM Society, Fort Worth chapter. 50 mi. radius.

Lubbock
WB5BRY (narrowband) 146.34 146.94
Has autopatch, 1805 Hz digital
W5YUO 146.16 146.76

Abilene 146.34 146.94

Austin
W5NFCO 146.34 146.94

Amarillo
W5CBT 146.34 146.94

Houston
WA5QLA 146.28 146.88
No call given (Port Arthur) 146.34 146.94
W5QGG (Midland) 146.34 146.94
No call given (San Angelo) 146.34 146.94
W5TOC (Big Springs) 146.34 146.94

UTAH

East Utah
WØPXZ (Grand Jct.,Colo.) 145.32 146.94

Salt Lake City, North Utah
WA7AKI 146.34 146.94
K7OEP (So. Idaho) 146.34 146.94
WA7GTU (Cedar City) 146.34 146.94

Southwest Utah
W7AKE (Las Vegas) 146.34 146.94
(plus other freqs. See Nevada listing)

VERMONT

Central Vermont
*W1ABI (Killington) 146.28 146.88
1800 Hz 146.34 146.88
2400 Hz 146.34 146.94
2400 Hz 146.28 146.94

Southern Vermont
WA1KFX (Mt. Snow) 146.31 146.88
1950 Hz 146.31 146.91
2250 Hz 146.31 146.94

South and southwestern Vermont
W1ALE (Concord , N.H.) 146.34 146.94

South and southeastern Vermont
(Timed for periodic duty cycles) 146.46 52.525
**K1MNS (Derry, N.H.) 146.25 146.76
Southeastern Vermont

*Northeast FM Repeater Assn.
**New Hampshire FM Assn.

Northern Vermont
VE2TA (Quebec) 146.52 147.50
W1KOO (Mt. Mansfield) 146.34 146.94
2400 Hz tone burst entry. Covers northern Vermont and northeast New York. Operated by Burlington ARC
No call yet (N. Vt.) 146.22 146.82
No call yet NW Vt.) 146.22 146.76
WA1KGM (Mt. Ascutney) 146.16 146.76
WA1KFZ (N. Adams, Mass.) 146.04 146.91

VIRGINIA

WB4HCX (Lynchburg) 146.34 146.94
(wideband in, narrowband out)
W4GCE (Lynchburg) 146.22 147.42
K8SXO (Ridgeley) 146.76 52.525
W4DXC (Richmond) 52.72 52.640
K8SXO (Ridgeley) 52.525 146.76
WB4KNX (Charlottesville) 146.28 146.94
Charlottesville Emergency Amateur Repeater Society. No tones; wideband in; narrow out.
WB4KNN (Newport News) (40 mi.) 146.34 146.94
W4NJE (Richmond; narrowband) 146.34 146.94
Whistle-on
No call (Virginia Beach) 146.22 146.97

WASHINGTON (STATE)

W7DAQ (Longview) 146.76 53.290
Intermittent
W7DAQ (Longview) 53.290 146.76
Intermittent
VE7MQ (Seattle) 146.34 146.58
Seattle 146.76 146.58
K7GMR (Seattle) 52.525 53.290
450 ft elev. Groundplanes. Very sensitive receiver; 40W transmitter. Cavity homebrewed by K7KSZ.
Yakima 145.26 147.21
K7TGH (Richland) 52.525 53.290
VE7APU 146.33 146.58
K7QKL (Mt. Rainier) 146.34 146.76
K7IUT (Olympia) 52.525 53.29
7200 ft 50W (wideband)
K7QKL (Pikes Peak) 146.34 146.76
5200 ft 900W (wideband)
WA7AJF (Vancouver) 52.92 53.46
Mt. Livingston; operated by Lower Columbia ARC.

Eastern Washington
K7LBV (Spokane) 52.525 53.29
WA7KYY (Mt. Spokane) 146.34 146.76
Operated by Inland Empire VHF Radio Amateurs. (Also covers northern parts of Idaho). Wideband.
W7PUG 146.34 146.58
W7DXX (Rattlesnake Mt.) 146.34 146.94
K7QKL (Mt. Rainier) 146.34 146.94

WASHINGTON, D.C.

WA3CJD 52.76 52.565
W3JCN 448.0 449.0
WA3DZD 146.34 146.76

WEST VIRGINIA

K8SXO 146.34 146.76

WISCONSIN

Waukesha
No call yet 52.72 52.64
40 mi. coverage.
Milwaukee Area FM Club.
W9AIQ (Sturgeon Bay: narrowband) 146.34 146.76
1800 Hz tone burst. 50 mi. radius. Covers northeast state and upper Michigan. Door Country ARC.
W9ROM (Milwaukee) 146.34 146.94
WA9LIV (Waukegan) 146.34 146.76
1950 Hz
WA9PBW (Madison) 146.34 146.76
2100 Hz

WYOMING

K7SDD (Sherman Hill 146.16 146.76
Covers Cheyenne and Laramie. Wideband in, 10 kHz out. Linked with WA7EGK. Wyoming Amateur Repeater Society (Slides available).
WA7EGK (Laramie) 146.34 146.94
Wideband in, 10 kHz out. Linked with K7SDD. Has autopatch (742-2447). (Slides available).
WA7OTP (Casper) 146.34 146.94
Linked with K7SDD
W7RPV (Boysen Park) 146.34 146.94
Covers Thermopolis, Riverton, Lander, and Worland, Wyoming. 7500 ft. Local control.

FOREIGN REPEATERS

Germany
DLØSTA Stuttgart 144.46 145.75
(Mounted in "Space Needle")

Bavaria
No call (Zugspitz Mt.) 145.0 145.6.

National Standards for FM Operation

By popular demand, 73 presents this page of FM standards as a public service to the VHF community.

2m FM Channels

146.010 S	146.640	147.270 S R
146.040	146.670 S	147.300 R
146.070 S	146.700	147.330 S
146.100	146.730 S	147.360
146.130 S	146.760	147.390 S
146.160	146.790 S	147.420
146.190 S	146.820 R	147.450 S
146.220	146.85 S R	147.480
146.250 S	146.880 R	147.510 S
146.280	146.910 S R	147.540
146.310 S	146.940 R	147.570 S
146.340	146.970 S R	147.600
146.370 S	147.000 R	147.630 S
146.400	147.030 S R	147.660
146.430 S	147.060 R	147.690 S
146.460	147.090 S R	147.720
146.490 S	147.120 R	147.750 S
146.520	147.150 S R	147.780
146.550 S	147.180 R	147.810 S
146.580	147.210 S R	147.840
146.610 S	147.240 R	147.870 S

6m FM Channels

52.525	53.020 S	53.520 R
52.540 S	53.040	53.540 S R
52.560	53.060 S	53.560 R
52.580 S	53.080	53.580 S R
52.600	53.100 S	53.600 R
52.620 S	53.120	53.620 S R
52.640	53.140 S	53.640 R
52.660 S	53.160	53.660 S R
52.680	53.180 S	53.680 R
52.700 S	53.200	53.700 S R
52.720	53.220 S	53.720 R
52.740 S	53.240	53.740 S R
52.760	53.260 S	53.760
52.780 S	53.280	53.780 S
52.800	53.300 S	53.800
52.820 S	53.320 S	53.820 S
52.840	53.340 S	53.840
52.860 S	53.630 R	53.860 S
52.880	53.380 S R	53.880
52.900 S	53.380 S R	53.900 S
52.920	53.420 S R	53.920
52.940 S	53.440 R	53.940 S
52.960	53.460 S R	53.960
52.980 S	53.480 R	53.980 S
52.000	53.500 S R	

10m FM Channels

29.020 S	29.360
29.040	29.380 S
29.060 S	29.400
29.080	29.420 S
29.100 S	29.440
29.120	29.460 S R
29.140 S	29.480 R
29.160	29.500 S R
29.180 S	29.520 R
29.200	
29.220 S	29.540 S R
29.240	29.560 R
29.260 S	29.580 S R
29.280	29.600 R
29.300 S	29.620 S R
29.320	29.640 R
29.340 S	29.660 S R
	29.680 R

220 MHz FM Channels

220.020	221.020	222.020	223.020	224.020
220.060	221.060	222.060	223.060	224.060
220.100	221.100	222.100	223.100	224.100
220.140	221.140	222.140	223.140	224.140
220.180	221.180	222.180	223.180	224.180
220.220	221.220	222.220	223.220	224.220
220.260	221.260	222.260	223.260	224.260
220.300	221.300	222.300	223.300	224.300
220.340	221.340	222.340	223.240	224.240
220.380	221.380	222.380	223.380	224.380
220.420	221.420	222.420	223.420	224.420
220.460	221.460	222.460	223.460	224.460
220.500	221.500	222.500	223.500	224.500
220.540	221.540	222.540	223.540	224.540
220.580	221.580	222.580	223.580	224.580
220.620	221.620	222.620	223.620	224.620
220.660	221.660	222.660	223.660	224.660
220.800	221.800	222.800	223.800	224.800
220.740	221.740	222.740	223.740	224.740
220.780	221.780	222.780	223.780	224.780
220.820	221.820	222.820	223.820	224.820
220.860	221.860	222.860	223.860	224.860
220.900	221.900	222.900	223.900	224.900
220.940	221.940	222.940	223.940	224.940
220.980	221.980	222.980	223.980	224.980

450 MHz FM Channels

The 450 MHz FM spectrum is included in the ten megahertz from 440 to 450 MHz. Channels are established at 50 kHz increments throughout. Repeaters are separated by 5 MHz. The upper frequency should be the repeater input; the lower, the output.

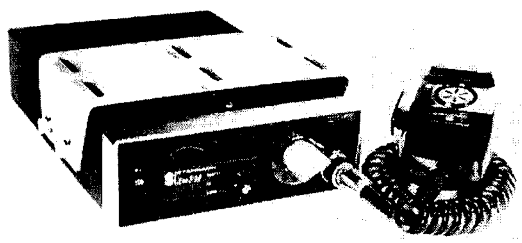
Standard amateur deviation: ±15 kHz. 36F3 emission is recommended on all channels except those channels marked "S". S channel emission is 16F3. Channels marked "R" are RACES frequencies as promulgated by the Office of Civil and Defense Mobilization.

The FM Marketplace

. . .A detailed rundown on all the current models of 2m FM transceivers.

FM's fantastic rise in popularity has brought about a revolution in the ham market, with manufacturers young and old competing for a share of the business. 73 considered publishing detailed product reviews on all the equipment available, but new equipment continues to make the scene at a clip far too furious for reviews to keep pace. As an alternative, we decided to publish "capsule reviews," where all the 2m FM transceivers could be listed together and described in one sequence of pages, thus allowing amateurs to compare price, performance, features, and appearance.

To do this, 73 requested evaluation models of all rigs currently being manufactured. Then, as the units came in, they were systematically checked out and photographed. The specifications were listed and comprehensive descriptions prepared. The following paragraphs represent the results of the lengthy evaluation effort. The 2m FM units pictured and described herein are: Clegg, Drake, Galaxy, Regency, Simpson, Standard, Swan, Telecomm, Tempo, and Varitronics. The reviews also include two portable units – one by Varitronics, the other by Drake.



Standard's new SR-C826M uses a beefed-up receiver borrowed from the company's type-accepted line of marine units. Among other improvements over the early Standards: more rf amplification stages and increased selectivity.

STANDARD

Standard's SR-C826M is a 12-channel transceiver that runs 10W of rf output power, has a receiver sensitivity of 0.4 μV for 20 dB of quieting, and sports an illuminated selector switch and S-RF meter. The transceiver comes from the supplier with 4 frequency positions installed: 146.94 direct, 146.34/146.76, 146.34/146.94, and 146.76 direct. The Standard unit comes from the factory equipped with microphone, mobile mounting bracket, power cable and cord.

The transmitter frequency deviation is preadjusted to ± 7 kHz, a good figure for most of the repeaters in the country; an internal adjustment will vary the level from 0 to 10 kHz. A front panel switch allows selection of rf output power to conserve drain when operating off an uncharged battery. The high-power position is 10W out; the low-power position drops the output to slightly below a watt. In the low-power position, battery drain is about a quarter-amp during transmit. Under normal weather conditions (-10 to +60°C), the frequency drift of the unit is less than 0.001% – depending, of course, on the quality of crystals you use. The SR-C826M is reportedly a drastic improvement over the earlier model (SR-C806M) in terms of selectivity. One of these units was functioning at SAROC as an in-band repeater. Sales price: $339.95 . *Standard Communication Corp., Box 325, Wilmington CA 90744.*

VARITRONICS

The Inoue IC-2F, distributed exclusively by Varitronics, Inc., has 6 transmit and 6 receive channels that can be independently selected with concentric switches. Even though the rig is packed with compact circuitry, the unit is remarkably serviceable, owing to the "swingaway" construction of the subchassis elements. The receiver is rated for 0.4 μV for 20 dB quieting, which has proved realistic. The selectivity is adequate for amateur mobile and base operation, but you won't likely be able to use the transceiver as a functioning repeater.

The transmitter uses 18 MHz crystals; the receiver uses 45 MHz rocks. Construction and layout are exceptionally clean. A 5-prong receptacle on the rear of the chassis simplifies interconnection of tone accessories and allows discriminator frequency monitoring via a remote meter. A plug for this is provided with the unit.

The unit comes complete with mike, mobile mounting bracket, power connector/cable, spare fuses, and a mike hanger. Connect 12V and a good antenna and you're on the air with a good 10W of rf. A built-in protection circuit senses high standing-wave ratios and will cut off the transmitter when the value climbs too high, thus saving expensive power transistors. Indirect illumination of the built-in S-RF meter serves as "power" and "transmit" indicators: When the power is on, the meter is lit with an ordinary low-drain incandescent lamp; on transmit, a brilliant ruby lamp illuminates the meter. Provided with comprehensive maintenance/operation manual, 1 year guarantee. Comes with crystals for 146.34/146.94 and 146.94 simplex. Sales price: $299.95 *Varitronics, Inc., 2321 E. University Dr., Phoenix AZ.*

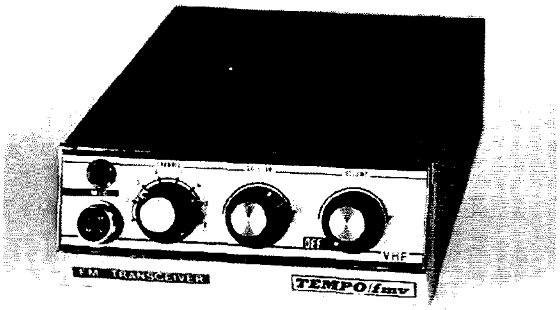
The Varitronics IC-2F has about the highest packaging density of any transceiver on the market, with more circuits per square inch of volume and less dead-air space inside the cabinet. The large panel meter lights up red during transmit. Unprecedented sales volume has allowed the distributor to drop the sales price recently to $299.

TEMPO

Henry Radio's Tempo FMV transceiver is one of the more compact of the imported units. Housed in a sturdy one-piece metal case, the unit comes with power cable, microphone, and one set of crystals – 146.94 (transmit and receive).

There are 8 positions on the channel selector switch and sufficient crystal sockets for 8 transmit and 8 receive crystals. Cross-wiring for accessing one crystal in several positions is a simple process.

The transmitter section is rated at 10W output, though the 73 test unit actually pumped out 15W into a 50Ω antenna (13.8V input). The receiver sensitivity is rated at 1.0 μV for 20 dB of quieting, but



The Tempo FM-V import offers an unusual buy in terms of performance-per-dollar-of-investment. At $225, the unit will produce up to 15W of rf, and offers sensitivity, selectivity, and noise immunity comparable to the highest priced transceivers. Though the FM-V has no panel meter, it does contain an internal meter socket that allows monitoring of all stages, including discriminator.

73's test unit did much better (0.6 μV). The selectivity is better than average. Noise immunity is definitely superior.

The transceiver chassis contains a metering socket for monitoring all the transmitter and receiver stages. A 0–50 μA meter can be used for monitoring these functions (including discriminator current), or you can purchase a low-cost test set from Henry that is designed to plug in.

With its 29 transistors, 2 integrated circuits, and 15 diodes, the unit is surprisingly compact; and with all its compactness, the unit is surprisingly accessible for service. It comes with a complete instruction manual that describes tuneup and alignment procedure, photos of the transceiver, theory of operation, parts lists, schematics, and a warranty. Sales price of the Tempo FMV: $249.00. *Henry Radio, Inc., 11240 W. Olympic Blvd., Los Angeles CA 90064.*

SWAN

The FM-2X by Swan Electronics is a 12-channel transceiver with a rated rf output power of 12W. According to Swan, the unit comes factory-equipped for crystals on 146.34/146.94 and 146.94 simplex. 73 has not yet had the opportunity to check out this unit, but the specs are as follows: Harmonics and spurious radiation better than −60 dB; frequency deviation is factory adjusted to ±12 kHz, but may be increased or decreased with integral pot. The receiver is rated at better than 0.6 μV sensitivity at 20 dB quieting. With a dual-conversion superheterodyne circuit, the unit is certain to give adequate selectivity for amateur mobile or base station use.

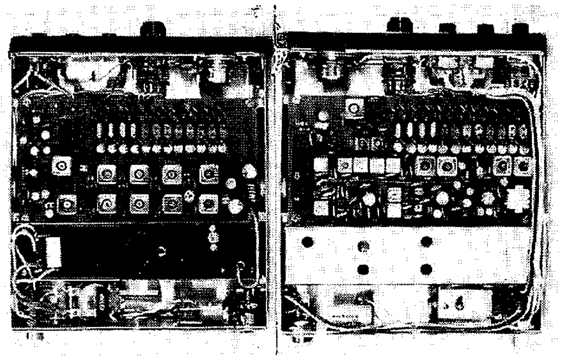
Swan's FM-2X import boasts a series of 12's: 12W, 12 channels, and factory deviation adjusted to 12 kHz. A large illuminated panel meter and a back-lighted frequency selector make mobile operation an easy chore even at night. The unit operates either direct from the car battery or from 115V ac (for base station operation). Power cords are supplied for ac and dc operation.

The unit sports an easy-to-read, illuminated panel meter for indicating relative power during transmit and relative signal strength during receive. With 28 transistors, 12 diodes, and an integrated circuit, the FM-2X comes complete with power cable (and connector), operating manual, and standard Swan guarantee. Sales price: $229. *Swan Electronics, 305 Airport Rd., Oceanside CA 92054.*

GALAXY

Hy-Gain's Galaxy FM-210 transceiver is all-American. Manufactured in the U. S. with U. S. parts, the unit offers conservative design with plenty of room inside the chassis for mounting tone units or other circuits. With independently controllable transmit and receive frequencies, a great deal of flexibility is offered in terms of selection of operating frequencies (9 possible, with 3 crystal positions for transmitter and 3 for receive.) FETs in the front end serve to enhance sensitivity with a minimum of active devices. Receiver is rated at 1.0 μV for 20 dB quieting. The basic transmitter runs about 3.0W out, but this can be doubled with the optional "power booster" accessory. Crystals for transmit and receive on 146.94 MHz are

The FM-210 by Galaxy offers 9 channels (3 x 3), easy access for service, and traditional U.S. quality. A power-booster accessory, available at extra cost, increases the value of the FM-210 by upping its output to 35W. This unit has the distinction of being the "American Classic." Like the Ford automobile, Galaxy pioneered the American penetration into an all-import market with this sensibly priced transceiver.



The Telecomm transmit board (left) is accessible from the top of the rig's mobile housing. As shown, the 12-channel board is easily removable. The transmit board drives the rf power amplifier shown at the bottom of the photo at left. Note also the integral hash filter. The receiver portion (right) is accessible from the underside of the chassis.

provided. The audio output power is very high quality and the level is sufficient for the noisiest of environments. The microphone input is designed to accept any high-impedance audio input. The transmitter deviation level can be adjusted to any point from 0 to 15 kHz. Plug-in transistors and easy-access circuit boards simplify servicing. Provided with operation manual, full guarantee. Sales price: $229.50. *Hy-Gain Electronics Corp., Box 5407-GL, Lincoln NB 68505.*

TELECOMM

The Telecomm import is a 12-channel transceiver with a rounded two-piece housing, front mounted speaker, and indirectly illuminated S-RF meter and channel selector. Rated at 10W output, 73's test unit actually produced 15W with 13.8V dc input. The front panel sports a unique multipower switch, which changes the output power to 2.5W (medium-power position) or 10 mW (low-power position). The audio quality is particularly clean.

The unit comes equipped with two sets of crystals (146.34/146.94 and 146.94 direct), and has provisions for accepting power amplifier, tone encoders, remote control circuitry.

The receiver section is rated for 0.6 μV for 20 dB of quieting. Selectivity and noise immunity seem to be on a par with other imports – plenty adequate for amateur mobile or base station operation. Transmitter and receiver oscillators are equipped with trimmers for rubbering crystals to precise channel variations. To ease servicing, the transceiver circuit boards are modular; the transmitter is accessible from the underside, the receiver from the top. The transmitter uses 12 MHz crystals (12X); the receiver, 45 MHz crystals. The i-f lineup is the standard 10.7 MHz/455 kHz arrangement. Comes with schematics and simplified operating instructions. Sales price: $289.95. *Telecomm Electronics, Box 461, Cupertino CA 95014.*

Telecomm, a California company, imports the 10W unit pictured here, but stocks the integral modules as well. The module boards include the receiver, transmitter, and rf power amplifier. The Telecomm has 12 transmit and receive crystal positions, a front-mounted speaker, and three switch-controlled power output levels.

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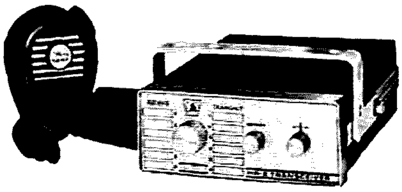
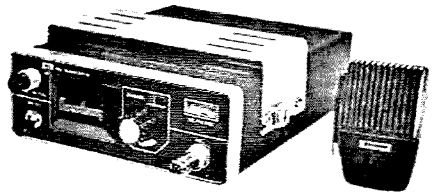
REGENCY HR-2 FM Transceiver, 2 meter band coverage 144—148 MHz, receiver crystal controlled, sensitivity .35 μV, 20 dB quieting, 6 channel, 10 watt output, all solid state, power supply 13.5VDC self-contained, size 5½W X 2¼H X 7¼D, with high Z ceramic microphone, mounting bracket and crystal 146.94 MHz, price **$229.00.**



CLEGG 22'er FM Transceivers, full 2 meter band coverage 143.4 to 148.3 MHz, receiver is tunable in 100 kHz increments and readable to 25 kHz. Sensitivity .15 μV for 20 dB quieting, squelch threshold less than .1μV. Transmitter rating 55—65 watts DC input, 25 to 35 watts output. All internal circuits broad banded for 4½ MHz coverage. Final amplifier broad banded for ± 500 kHz without retuning. Solid state circuitry with 8150 final amplifier, 9 channel transmitter, 115VAC and 12.6VDC self-contained power supply, size 12½W X 5½H X 11½D, price with PTT microphone and crystal 146.94 MHz, price **$369.95**

DRAKE MARKER FM Transceiver, 144 to 148 MHz, 12 channel crystal controlled, sensitivity 0.5 μV or less, 20 dB quieting, 12 channels, 10 watts output, size 7-7/8W X 2¾H X 10¼D, power supply 13.5VDC and 117VAC, with dynamic microphone, antenna, cords, and 2 channels 146.94 MHz and 146.94/146.34 simplex, price **$329.95.**



TEST EQUIPMENT

TS-413/U Signal Generator, 75 kHz to 40 MHz in 6 bands, precise calibration from 1 MHz crystal oscillator, has % modulation meter, CW or AM, 400/1000cps, variable 0—50% and RF level meter 0 to 1.0V, ideal for amateur, marine, aircraft, hobbist for IF and receiver alignmentt . . $89.50

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Ballantine Model 300 AC Voltmeter, range 1 mV to 100V in 5 ranges, 10cps to 150ac, ideal for audio work $29.50

TS-592/UPM-15 Pulse Generator, 50 to 10,000pps, 115VAC/60cy $39.00

I-193 RTTY Polar Relay Test Set, used also to test external telegraph circuits $14.50

TS-330/TSM Crystal Impedance Meter, freq. range 1—15 MHz, resistance range 0 to 9900Ω capacitance range 12 to 110 $\mu\mu$F $65.00

OS-57/USM-38 Oscilloscope, DC to 6 MHz, 3WP1 tube, a nice general purpose oscilloscope $85.00

TS-147 Radar Test set, 8500—9600 MHz $90.00

Stoddart URM-6 (NM-10A) RFI Meters, 10 kHz to 250 kHz, the best $275.00

TS-418/U Signal Generator, 400 to 1000 MHz, AM, CW, PM, power output 1mw $225.00

TS-175/U Frequency Meter, 85 to 1000 MHz, accuracy 0.05%, audio modulation 1000 cycles $45.00

TS-382 Audio Oscillator, 20 to 200,000 cycles, one of the best $79.50

H.P. 100D Frequency Standard, provides 5 sinusoidal standard frequencies, 10cps, 100cps, 1kc, 10kc, 100kc, marker pips are at 100, 1000, and 10,000 usec, 2" CRT $65.00

TS-403/U Signal Generator, 1800—4000 MHz, ±1%, CW, FM, PM; PRR 40 to 40,000 pps, power output 1mw, 0 to —127DBM, variable voltage output .1 to 224,000 mV, output impedance 50Ω $145.00

TS-11/AP Portable DC Milliameter, 0—1 plus 0—25dcma ranges, mounted in nice wooden case $22.50

TS-170/ARN-5 Glideslope Test Set. $17.50

USM-105 Oscilloscope, military version of H.P. 160B, with dual trace plug-in, 20 mV/cm sensitivity. Chopped or alternate switching, .1usec to 5 sec/cm time base, beam finder, DC to 15 MHz, a fine lab scope $345.00

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DRAKE

The *Marker Luxury* by Drake represents a sensible compromise in hybridization. Combining a tube-type final with solid-state oscillator, multiplier, and driver stages to give an output signal that exceeds 20W (With an input of 13.8V dc), the transceiver offers a total of 12 channels, compact construction, and excellent overall performance. The receiver section is more selective than most, and can quiet the noise by an honest 20 dB with only a half-microvolt input. A particularly interesting feature of the Marker Luxury is the built-in 115V power supply, which means that the unit can be operated in the car or as a base station with no additional appliances. The unit comes equipped from the factory to transmit and receive on three channels: 146.34/146.94, 146.34/146.76, and 146.94 simplex. Included in the purchase price are the mike, power cords and cables, mobile mounting bracket, coax, and a ¼ wave mobile antenna.

For some reason – probably known only to Drake – the Marker Luxury is extremely conservatively rated. The 73 test unit performed far in excess of the specifications, and earned the Marker Luxury a vote of confidence from the editor, who lamented the incorporation of a vacuum tube in the transmitter before he actually had a chance to try out the radio.

The overall construction of the Marker Luxury is similar to that of other Drake units: solid, stable, classy. The design is like the specs – tasteful and conservative. The speaker is front-mounted, and a meter is provided for monitoring rf output during transmissions or signal strength during the receive mode. Sales price: $329.95. *R. L. Drake Co., 540 Richard St., Miamisburg OH 45342.*

Drake's Marker Luxury is designed as a mobile/base station. An integral supply allows connection to 115V primary power; the supply is bypassed when the unit is connected to a car battery. The Drake unit has a back-lighted channel indicator and an illuminated meter. Crystal positions are provided for 12 each, transmit and receive. Each crystal has an adjacent micro trimmer. Though rated at 15W output, typical Marker Luxury units approach the 20W mark.

REGENCY

Regency's HR-2 is a compact American-made economy model that uses a Motorola 10W transistor in the final amplifier stage. The channel selector is a 12-position switch that allows 6 each transmit and receive channels plus 6 cross-wired channel combinations. The extra-large speaker is mounted facing upward in the one-piece housing. Removal of the speaker gives easy access to all circuits.

Regency's HR-2 is one of the few American-made 2m FM transceivers. Though not the smartest-looking of the units available, there's probably not a unit anywhere that is easier to service. When the extra-large speaker is moved aside, all parts of the HR-2 are easily accessed. The compact transceiver is characterized by design economy and adequacy of performance.

The receiver section is rated for 0.35 μV for 20 dB quieting; 73's test unit did not quite meet this spec – though it did perform within the 0.5 μV figure that is fairly typical of most available transceivers. The transmitter put out 12W with an input of 13.8V when the channel selector was on the 146.94 position, and the power drop-

ped to 10W on the 146.34 position. The unit comes with high-impedance ceramic mike, power cable and plug, and transmit and receive crystals for 146.94 MHz. The transmitter crystals have frequency-adjust trimmers, but the receiver does not. A built-in swr "mismatch protection" circuit prevents operation with improperly tuned, open, or shorted antennas. The receiver i-f's are 10.7 MHz and 455 kHz. Receive crystals are 45 MHz types. The transmitter stage uses 6 MHz crystals. Comes with 5½ x 8½ in. operating manual, 90-day warranty, necessary accessories. Sales price: $229. *Regency Electronics, Inc., 7900 Pendleton Pike, Indianapolis IN 46226.*

CLEGG

The Series 25 Clegg 22 FM'er is a radical departure from the traditional, and the manufacturer gambled against heavy bets within the FM fraternity that a tunable receiver wouldn't make it. Clegg wins! Though the unit is designed primarily for base station applications, with its built-in ac supply, circuitry has been incorporated to allow use in the mobile by direct connection to the 12V battery.

Performancewise, the 22'er FM is almost incomparable. The receiver is remarkably sensitive (consistently better than 0.4 μV for 20 dB of quieting), and surprisingly selective, with an adjacent-channel level of −80 dB. The transmitter is crystal-controlled and has crystal sockets for 9 channels. The Series 25 receiver dial is calibrated in standard-channel increments of 60 kHz, with minor markers at the 30 kHz channel points. Reports from users of the 22'er generally state that the dial accuracy is extremely close; silent channels can be selected with precision, and no tuning is required to make sure you're really monitoring the right frequency.

The transmitter runs about 30W output, though this figure varies from unit to unit. Some reports have indicated outputs of up to 40W. The receiver and most transmitter stages are fully solid-state; the transmitter final is a tube. Design is clean; the knobs have that "executive feel." Sales price: $384.95. *Clegg Associates, Inc., Littell Rd., East Hanover NJ 07936.*

The Clegg 22'er uses vacuum tubes in the final to produce more power output than any of the available transistor rigs. The tunable receiver is calibrated to mark existing FM channels. The transmitter section is crystal-controlled, and runs approximately 35W out. The receiver section is highly selective and as sensitive as they come. Unit operates from 115V ac or 12V dc.

CLEGG SYNTHESIS

One of the most important developments in the FM era – indeed, perhaps THE most important – is the successful manufacture and marketing by Clegg Associates of the FM 27, a transceiver that incorporates a fully frequency-synthesized receiver section. To monitor a specific frequency, the operator merely sets the two receiver controls to the numbers corresponding to the 146 MHz channel. To monitor .94, the operator sets the first control to 9, the second one to 4. In the photo, the receiver is set to monitor .76. The beauty of this approach is that any one of 100 possible channels can be monitored with crystal accuracy – but without the need for crystals. And even such off-breed nonchannels as .80 and other sometimes used nonstandard frequencies

Clegg's FM 27 has one fantastic feature that tops all others: The receiver is a synthesis type, meaning that the operator can "dial" any channel he wishes to monitor by merely setting up the channel numbers on the two controls.

can be monitored, as long as the channels are multiples of 10 kHz between 146 and 147 MHz.

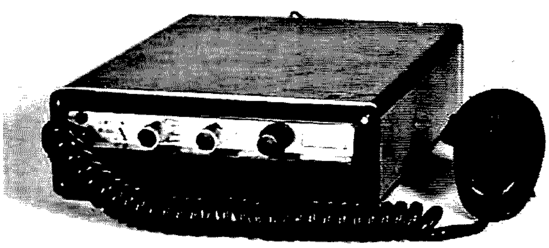
The transmitter portion of the transceiver is the 10-channel version from the company's 22'er model. The transmitter puts out about 30–35W of rf, and is said to be exceptionally stable. The design is clean, as it is with all Clegg units. As can be seen in the photo, accent is on simplicity and ease of operation.

Though 73 has not had the opportunity to evaluate one of these units (they're just out at this writing), the manufacturer's specs look very promising. The selectivity of the receiver is rated at 80 dB of adjacent-channel attenuation. The sensitivity figure is rated at 0.25 μV for 20 dB of quieting.

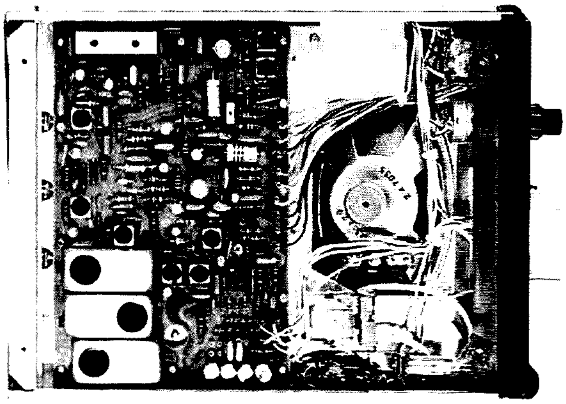
SIMPSON

Simpson's Model A FM transceiver steps into amateur radio from the nearby VHF FM marine band, where it has been – and still is – serving boat owners and yachtsmen. The Model A's rugged construction is probably attributable to this heritage; the rig is built like a battleship, and from first appearances one might guess that nothing could damage it.

Although a smidgen larger than most of the other solid-state 2m FM units, the Model A's power output is slightly less than average – about 7.5W at 13.2V dc input. This rig's big plus is its serviceability; the circuit boards are laid out in



The Simpson Model A transceiver is one of the few that have received FCC type-acceptance for operation on the adjacent marine band. This durable FM unit has removable top and bottom cover plates that give easy access to internal circuitry. Sufficient volume exists inside the housing to mount tone units or other add-on circuits.



As can be seen in this view of the Simpson, the tuned circuits are all enclosed in shielded metal housings; and the trimmers are all of the air-variable variety. A very large speaker, mounted in an acoustical chamber, is capable of coupling several watts of audio into the air. Active devices of the Model A include several integrated circuits.

such a manner that virtually every stage of both the transmitter and the receiver sections are easily accessible for repair should the need arise.

Two channel-selector switches adorn the front panel of the Simpson Model A – one for the receiver, the other for the transmitter. With four channels transmit and four channels receive, the total number of transmit/receive combinations are 16.

The Model A comes with crystals for operation on .94 (direct) and .34/.94. Other factory equipment includes power cable and connector, push-to-talk microphone, fuse, mike hanger, mounting hardware, and an operation/maintenance handbook.

The unit houses an extra-large speaker housed in a clever acoustical chamber that supplies very loud and crystal clear audio under adverse conditions of a noisy environment. Receiver sensitivity is about 0.5 μV for 20 dB of quieting, and the selectivity is –60 dB at 36 kHz. Sales price: $245. *Simpson Electronics, Inc., 2295 NW 14th Street Miami FL 33125.*

HANDIE-TALKIES & PORTABLES

DRAKE TR-22

The TR-22 is a very compact transceiver that can only be classed as a "portable." With the general shape of a conventional mobile transceiver and the size of 1½

late-model hand-held units, the little rig runs a watt and a half of rf out into its own integral telescoping whip antenna. The rig is set up to do triple duty – as a handheld unit, a base station, and a mobile.

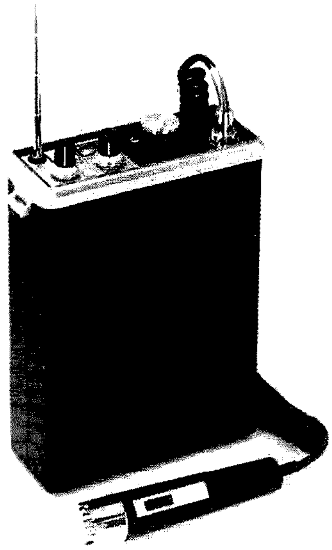
For hand operation, the unit sits in its leather carrying case with shoulder straps. The slim "pencil" microphone connects to the transceiver through a curly cord, and the telescoping whip extends from the face of the unit. An internal pack of "penlite" rechargeable Nicads supplies 12V to power the rig. The case is easily removeable (without tools), but provides a splashproof housing for the transceiver and its speaker.

As a mobile, the unit can be connected under the dash. A standard UHF connector is provided on the rear panel of the chassis along with a connector for accepting battery voltage. A mating connector and power cable are furnished with the TR-22.

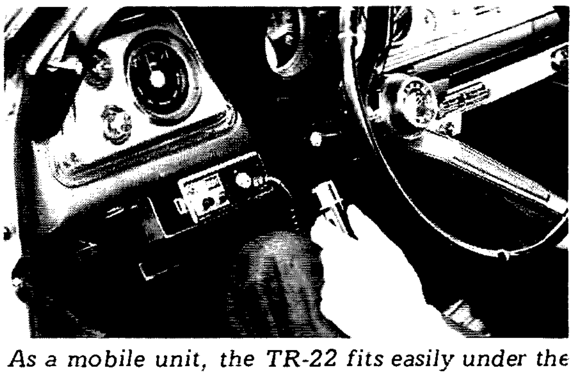
As a base station, the unit becomes operable by connecting a 115V power cord between the unit and household power. (The proper cable, resembling a TV "cheater" cord comes with the transceiver. A unique accessory is available that includes an rf output amplifier and a receiver preamplifier (AA-22, $149.95, 25W).

Operationally, the TR-22 has 6-channel capability, and cross-wiring is easy. The receiver checks out at 0.5 μV for 20 dB quieting. Selectivity is fair: noise immunity is average. For quality of overall package, and construction/layout, the TR-22 rates an A+. $199.95. *R. L. Drake Co., 540 Richard St., Miamisburg OH 45342.*

As a portable unit, the TR-22 operates from its own self-contained batteries. A carrying case and shoulder strap are provided with the unit, as is the pencil microphone with its curl cord. Power output is between 1.1 and 1.5W, depending on condition of batteries.



The TR-22 is about half the size of the smallest mobile units, and includes virtually all the performance features of the big rigs while retaining that elusive ingredient called portability. The unit has 6 channels, independent squelch and volume controls, and a panel meter to indicate the capacity of the integral batteries. The unit is powered from an internal battery pack, external auto battery, or 115V ac. In addition to the front-mounted telescopic whip, the unit has a conventional UHF connector on the rear to facilitate operation as a mobile or base station.



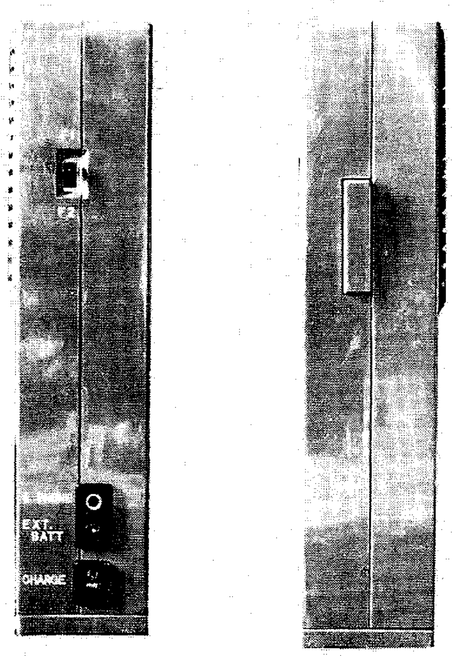
As a mobile unit, the TR-22 fits easily under the dash of even the most compact car. It connects directly to the car battery and an external antenna. The speaker is splash-proof, and the unit can be removed from the case without tools; two unique push clips hold the unit in its one-piece housing.

VARITRONICS HT-2

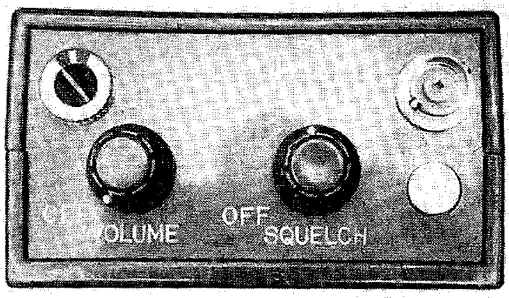
The HT-2 hand-held 2 meter transceiver is the only "handie-talkie" currently being marketed specifically for the amateur market. Amateurs interested in small packages and big performance should not overlook this sleeper. This unit was tested more thoroughly by 73 staff than any other FM transceiver, because it seemed to be too good to be true. The transmitter pokes out 2W, and the signal is good, clean, and stable. Early units had bassy audio, but recent models sound almost hi-fi. Deviation level on the transmitter is factory adjusted to about 10 kHz, and can be easily set to any requirement by pot adjustment.

The selectivity of the receiver is adequate, nothing more. But the sensitivity is unbelievable – 0.4 μV or better for 20 dB of quieting. It's something you'll have to measure for yourself to fully appreciate.

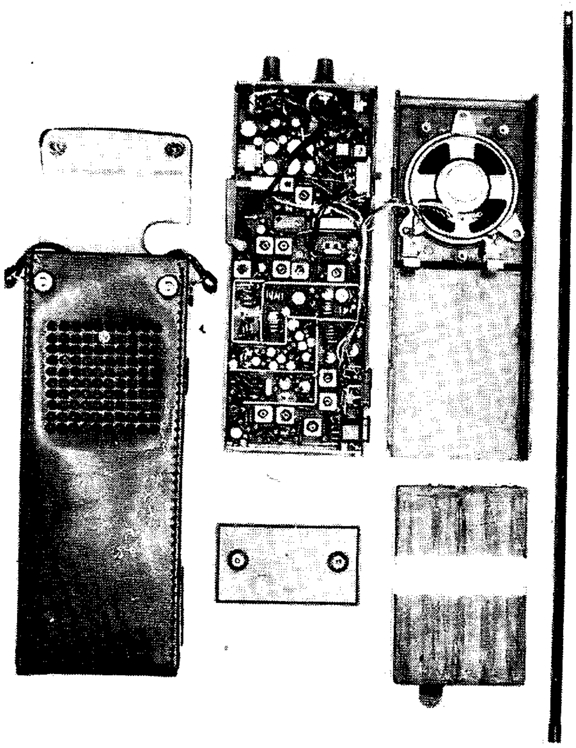
The package is definitely not Motorola quality even though the performance is. And even the plain packaging can be appreciated if you have to work on the unit. The whole thing comes apart to reveal well laid-out, easily serviceable stages, each well shielded from the other by metal barriers.



Varitronics' HT-2 is a 2-channel, 2W hand-held transceiver that comes with nicad batteries, carrying case, battery charger, and crystals for .34/.94 and .94 direct. Sensitivity of the receiver section is 0.4 μV for 20 dB of quieting.



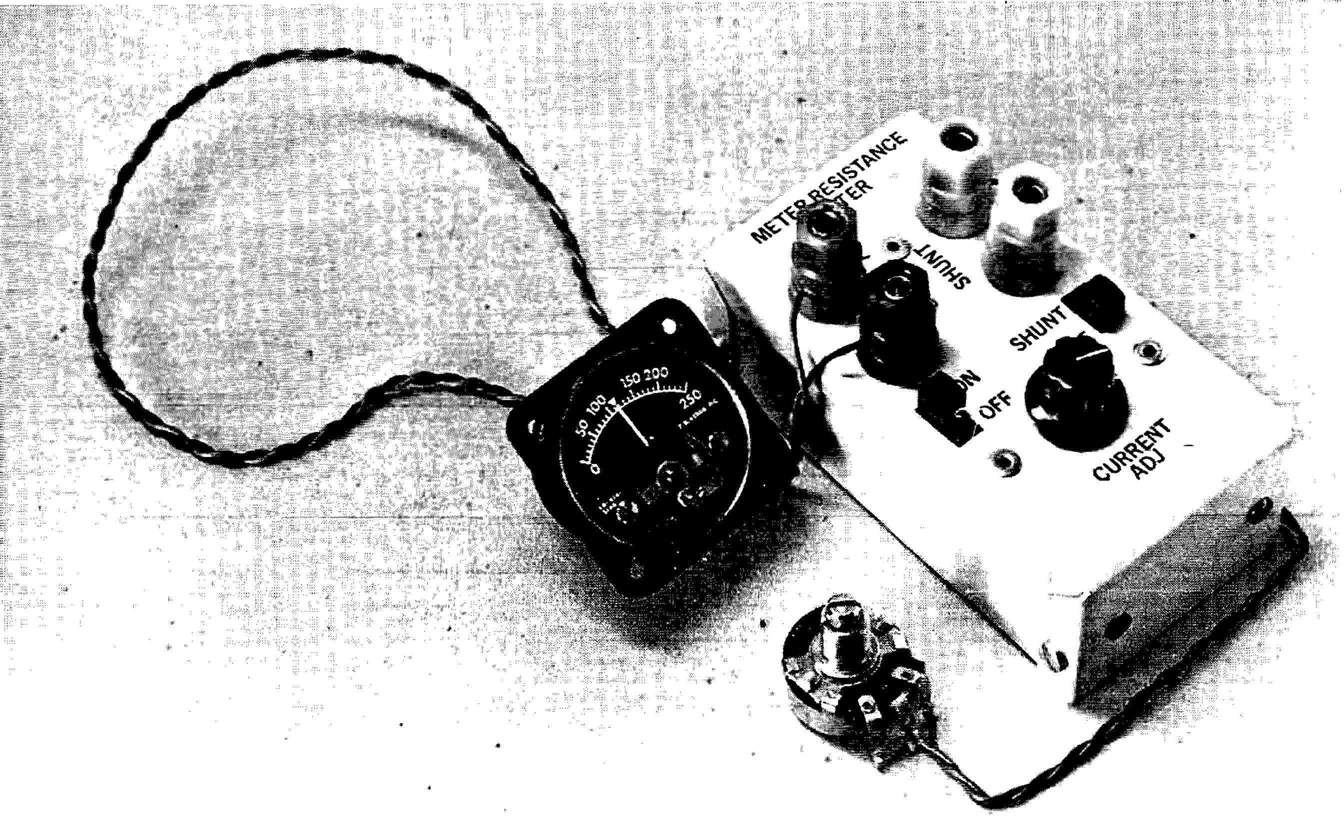
The top of the HT-2 contains on-off and volume control, squelch control, a BNC antenna connector (which also mates to the antenna supplied with the transceiver), and a battery-level indicator.



The stages of the HT-2 are isolated from one another by thin shielded partitions. The "guts" can be removed easily from the transceiver housing for service in the unlikely event that such action might be necessary.

The unit comes with carrying case, leather strap, earphone, nickel-cadmium batteries, and a charger. A top-mounted meter tells the state of charge of the battery at all times the unit is turned on. The antenna (also supplied) mates with a BNC connector on top of the unit itself. Sales price: $249.95. *Varitronics, Inc. 2321 E. University Dr., Phoenix AZ.*

. . .Staff ■



THE METER EVALUATOR

Meter resistances may not always be as they seem. . .

To the serious experimenter, one of the most useful electronic components is undoubtedly the ordinary meter, and in an effort to obtain more precise measurements, an increasing number of hams are turning to the moderately priced surplus and imported units now appearing on the market. As any experimenter knows, however, with such a wide variety of types and styles available, it is virtually assured that no matter what the intended application, the available unit will always have the wrong range. To use such a meter, then, it is usually necessary to construct a shunt or a multiplier; and this, in turn, requires a

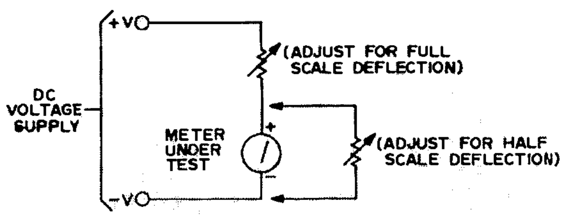
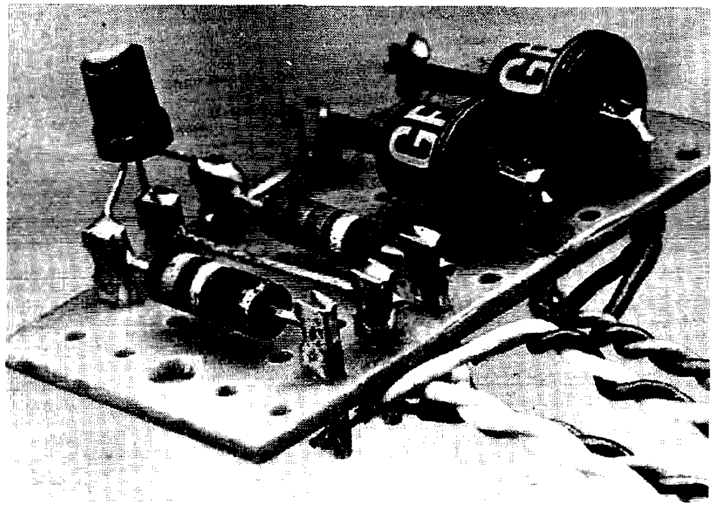


Fig. 1. Standard circuit for measuring meter resistance.



Circuit board of the meter evaluator. The twisted pairs go to: shunt switch and R_X binding posts, METER binding posts, battery and current switch, and R3. (Photo by Dale J. Ritter.)

knowledge of the meter's internal resistance. Since this parameter is rarely specified on the meter itself, it further becomes necessary that the experimenter be able to measure it as accurately as possible. In this respect, it is sad to say, conventional techniques leave a great deal to be desired.

It often comes as a surprise, particularly to those who wind their own shunts and who trust their meters, to learn that by using one conventional technique, it is entirely possible for readings to be off by as much as 50% or more! Obviously, the accuracy of the method by which internal resistance is measured must be carefully considered, since the usefulness of the meter depends upon it. The purpose of this article is to examine the error incurred by the standard technique for measuring meter resistance, and to suggest a method which will overcome its limitations.

Measuring Meter Resistance (The Old Way)

The standard method of measuring internal resistance, covered in virtually every text on dc measurement, is the familiar two-resistor technique of Fig. 1. The circuit is discussed in the *Radio Amateur's Handbook* and the explanation given of how it works is fairly typical: The meter to be measured is connected in series with a stable dc voltage and a variable resistor, adjusted to produce full-scale deflection. A second resistor is then shunted across the

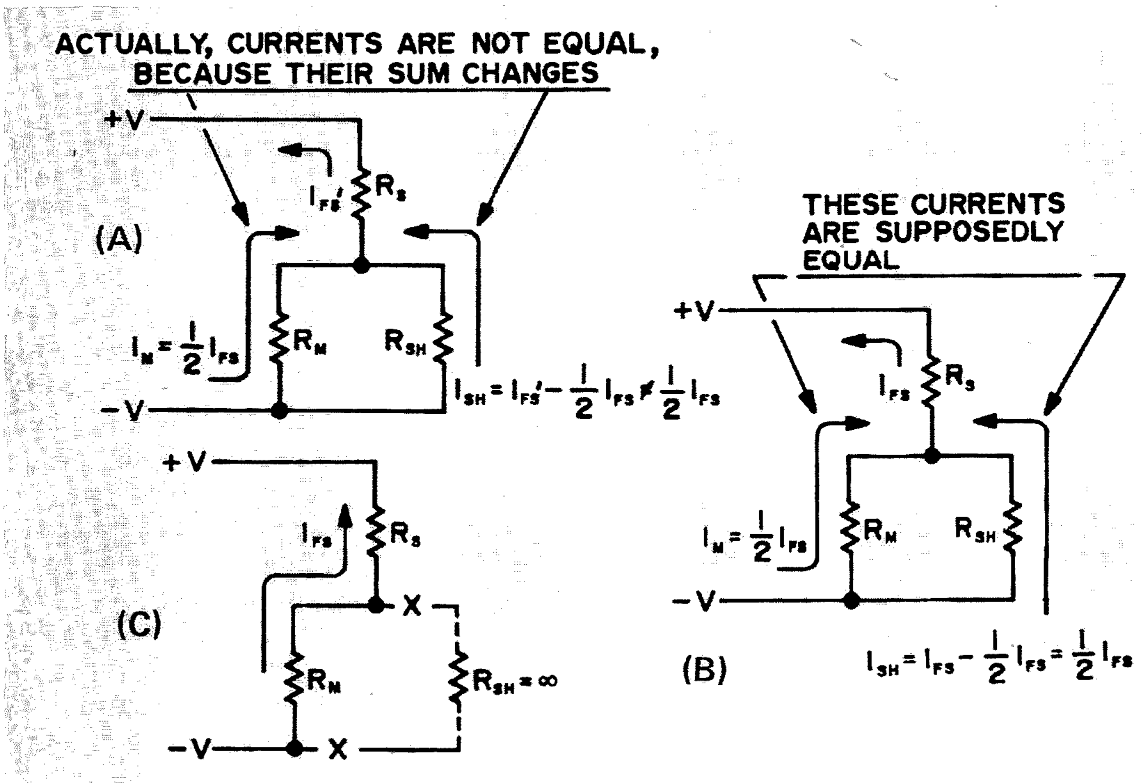


Fig. 2. The two-resistor technique. (A) R_{SH} disconnected and R_S adjusted for full-scale deflection. (B) What supposedly happens when R_{SH} is reconnected. (C) What actually happens! Note that I_M and I_{SH} are not equal if I_{FS} changes.

Front view of meter evaluator. (Photo by Dale J. Ritter.)

meter and adjusted to produce a deflection of half scale. At this point, it is claimed, the meter resistance is exactly equal to the shunt resistance, so that by disconnecting and measuring the shunt resistance one can determine the resistance of the meter. Unfortunately, that's not always the way it works out. The method is very widely used; it's cheap, simple, fast, and uses readily available junkbox parts. But it can also lead to considerable error; to see why, let's examine the operation of the circuit a little more closely.

The problem may be put in perspective by considering the circuit as redrawn in Fig. 2. In A, with R_{SH} disconnected and R_S again adjusted for full-scale deflection, a total current I_{FS} flows through the meter, and adjusted to produce half-scale deflection (sketch B), the total current divides between the two branches. If the total current is I_{FS}, then

$$I_{SH} = I_{FS} - \tfrac{1}{2}I_{FS} = \tfrac{1}{2}I_{FS}$$

and therefore the currents are equal. Since the voltages across the meter and shunt resistances are also equal (they're connected in parallel, remember) it is obvious that their resistances should be equal. This situation is illustrated in sketch B of Fig. 2.

Is this what actually happens, however? No, it's not; let's look at the circuit again: The total current flow, we said, was I_{FS}, and that was certainly true before we connected R_{SH}.But how do we know that it is true afterward? The answer is, we don't – and that's precisely the catch: the addition of R_{SH} in fact *changes* the total current because it changes the total circuit resistance. The shunt current still represents the difference between the meter current (still $\tfrac{1}{2}I_{FS}$) and the total current, but if the total current no longer remains equal to I_{FS} and changes to some new value, say I_{FS}', then the shunt current will be given by

$$I_{SH} = I_{FS}' - \tfrac{1}{2}I_{FS}$$

which is not necessarily equal to $\tfrac{1}{2}I_{FS}$ (sketch C). In other words, when R_{SH} is connected and adjusted to produce a half-scale deflection, the currents I_M and I_{SH} are not necessarily equals, so that the meter and shunt resistances are not necessarily the same.

What Now, Boss?

After having uncovered the basic cause of error in the two-resistor measurement technique, our problem is how to get rid of it. The inaccuracy, as we have seen, is basically due to the fact that the total circuit current – the sum of the meter and shunt currents – changes with the addition the shunt. Seen from this perspective, a solution is obvious: simply feed both meter and shunt from a constant-current source, as shown in Fig. 3. This situation, in fact, is precisely what one obtains by greatly increasing the value of R_S, as suggested

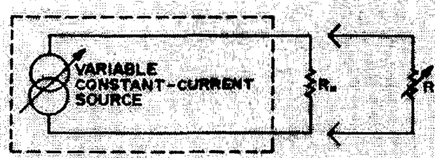
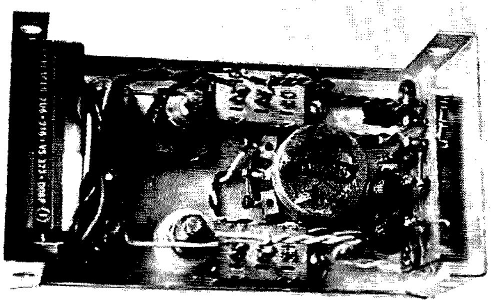


Fig. 3. A constant-current source is used to measure meter resistance.

earlier. One problem with that approach, already pointed out, is that it's difficult to know just how much to increase it without knowing the meter resistance itself. A second problem is that in order to maintain a constant current, any increase in R_S necessitates a corresponding increase in the supply voltage. A variable high-voltage supply designed to deal with these difficulties is certainly not impossible to build, but it is really a rather cumbersome way to handle the matter in view of the fact that a much more elegant solution is available.



Interior view of meter evaluator. (Photo by Dale J. Ritter.)

. . .Finally!

Since all we need to measure internal resistance with accuracy is a simple "black box" constant-current source, the contents of the "box" is immaterial, and any old circuit will do. One simple but effective approach is the circuit of Fig. 4, a modification of the one-transistor source commonly used in linear ICs.

Diodes D1 and D2 in the circuit act as voltage regulators, their intrinsic standoff potential being used to supply a stable voltage to the base of transistor Q1. Q1's beta should be as high as possible so that fluctuations in base current, due to variations in collector load resistance, do not significantly affect the base voltage. A GE 2N3390 or 2N3391 was selected as having the highest beta of any small-signal transistor known to this author (400 and 250, minimum, respectively), and their prices (90¢ and 61¢) are not unreasonable either. To further insure the stability of the base voltage, R1 should be chosen so that the current through D1 and D2 is large enough to swamp out any fluctuations in base current. If the bias current is small, the collector and emitter currents will be approximately equal, and if D1, D2, and Q1 are all silicon units, both will be given by

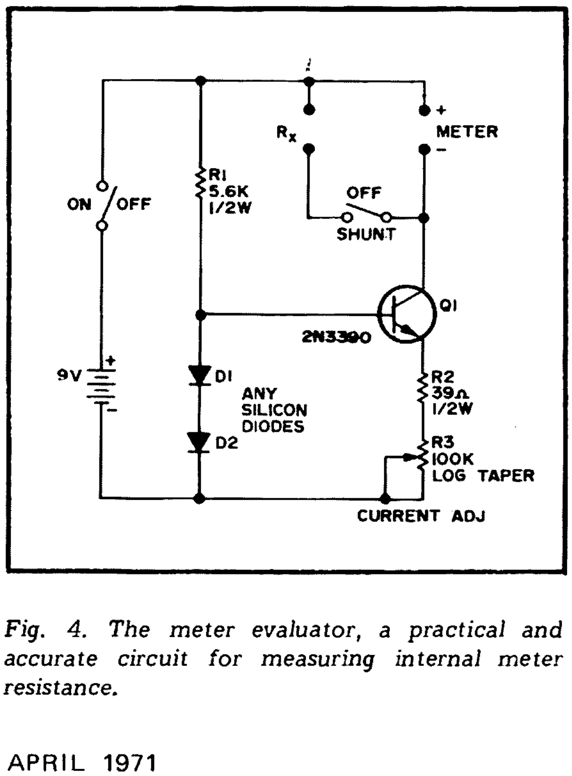


Fig. 4. The meter evaluator, a practical and accurate circuit for measuring internal meter resistance.

$$I_C \approx I_E \approx \frac{.65}{R_E}$$

where R_E, the emitter resistance, is the sum of resistors R2 and R3. In my own prototype, R_E is adjustable from 39Ω to 100 kΩ, which produces a current range of about 8μA to 13 mA – sufficient to measure most dc meter movements. The small parts are mounted on a 1¼ x 3/4 in. rectangle of Vector board, and the entire unit is housed in a 4¼ x 2¼ x 1½ in. aluminum minibox (Bud CU 3016A). The arrangement is convenient and compact, but otherwise the wiring is not critical.

To use the meter evaluator, connect the meter and shunt to the appropriate binding posts, then turn on the current and turn off the shunt switch. Rotate CURRENT ADJ until the meter reads full-scale. Flip the shunt switch to SHUNT and adjust the shunt resistor until the meter reads half-scale. The shunt resistance is then *really* equal to the meter resistance, and may be disconnected for measurement.

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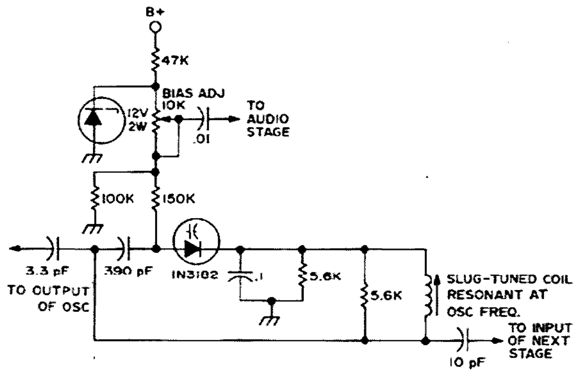
a simple varactor modulator for going FM

In the past few years, FM has become the big thing in amateur radio. It offers dependable, noise-free communication to thousands of hams around the country. If you have an old AM-type VHF transmitter, you can join right in with the rest of the guys who have discovered FM too, for only a few dollars. A simple add-on phase modulator can be used with any type of transmitter regardless of crystal or vfo control, because it varies the frequency indirectly by varying the phase of a tuned circuit.

The phase modulator has been around for years in commercial FM equipment in the form of a tube-type circuit that is still used today in some of the larger fixed commercial stations. A newer type of circuit shown here utilizes the varactor, a semiconductor device that can vary its capacitance by varying a bias voltage. This device is very practical for use as a phase modulator circuit because of its small size and low power requirements. The phase modulator is installed in the transmitter circuit betweeen the oscillator and the subsequent stage.

After the phase modulator circuit is installed, tune coil LI to resonance at oscillator's operating frequency by tuning for maximum output. Then, tune the bias adjustment for best distortion characteristics.

It is also helpful to install a transmitter preemphasis circuit, although it is not actually needed. A preemphasis network is an RC circuit in which, by the reactance of a low-value capacitor, the high



frequency audio is emphasized as compensation for unequal audio amplification characteristics, producing a better noise rejection pattern. As the reactance of the capacitor decreases with frequency, more of the higher frequency audio is passed through. In an FM receiver, however, a deemphasis unit deemphasizes the high audio tones back to their original form.

A lower value of the .01 audio coupling capacitor produces more preemphasis, and more capacitance produces less. If you can't dig up a 100 kΩ resistor, any high resistance will do.

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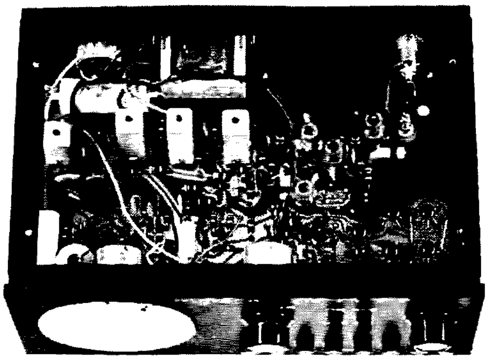
FM FUN with a SCANNER



As the number of repeaters grows, the active FM amateur finds that he wishes to listen to more than one channel at a time. The initial piling up of repeaters on 146.34/.94 has been giving way to a spreading out to other less active FM channels.

The obvious answer to the problem of listening to more than one channel at once is a scanning receiver. This is a lot simpler than buying or building a whole set of receivers, each tuned to a repeater channel. A scanner has an electronic switch that lets it tune to a series of channels, one after the other. As soon as it comes to one with a carrier on it the scanning stops and the receiver squelch opens up.

In the area where 73 Magazine is located there are nine great repeaters. Imagine, if you can, trying to switch from one to the other of all these. Three of the repeaters have 94 outputs, so all we need are seven scanning channels to hear all nine repeaters. The Electra Bearcat scanner has eight channels so we set it up to check the nine repeaters plus a .34 channel for copying local calls on the repeater input channel.

Now, whenever anyone comes on any repeater, we hear what is going on and can see the light on the scanner indicating what channel is busy. Once you try this system you quickly decide that this is the only way to fly.

The Bearcat has a provision for screwing in a collapsible vertical antenna if you are using it for portable monitoring or are in a strong signal area. You can plug in your station antenna for added sensitivity. It runs from either 12V dc or 115V ac, so you can use it at home or in your car.

There is a small slide switch under each of the eight channel lights enabling you to have the scanner omit any of the channels that you don't want to check. This is handy when, say, .94 is tied up with some long-winded chaps and you don't want to just sit and listen to them by the hour. You flip off .94 and the scanner checks all the other channels except .94.

The scanning mechanism may be turned off and the receiver will then monitor any single channel you desire.

Someday, in the distant future, some transceivers will probably include a scanner like the Bearcat. It may even automatically switch the transmitter to the appropriate channel for the repeater being received. In the meantime, there is the Electra Bearcat at just under $140, and it sure helps to make FM a lot more fun.

The Bearcat was originally designed as a VHF receiver for scanning fire, police, and other services using FM. The receiver easily tunes to 2 meters, so it was a natural for scanning 2m FM repeaters.

The receiver is a lot more elaborate than you might suppose. It is built on a printed circuit board and is apread out well enough to permit easy servicing. There are 23 transistors and six integrated circuits. Individual transistors are used for each of the eight crystal oscillators. ICs do the scan/switching.

Now 73 staff members take the Bearcat along on trips, permitting the FM bands to be scanned for activity wherever they go. Much of the activity would certainly be missed without this scanner.

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LOW COST SIGNAL SOURCE
for FM receiver tuneup

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For many years the Measurements Corporation Model 80 signalgenerator has been the industry standard for tuning rigs. Many hams have wanted to have a laboratory-grade signal source of this type but the $800 price tag is prohibitive. This article describes a signal source that has many of the same features as the 80 except that it only costs 1% as much. That's why I call this the Model 0.8.

You wonder at some of the features of the marvelous little device? To briefly list them, it has:

- Variable output from about 80 nV to 50 mV of rf power.
- Frequency range from 1.8 to 450 MHz so you can cover 160 through ¾ meters.
- Crystal-control frequency stability.
- Fairly clean output signal.
- A 51Ω antenna load.
- Safety feature to prevent the destruction of the device in case a transmitter is accidentally loaded into it.

The Circuit

The circuit is the combined brainchild of many ham engineers and technicians in our local 2m FM club – the Toronto FM Communications Association. More than 300 of these units have been built in the past two years, so the circuit has been exceptionally well tested in the field.

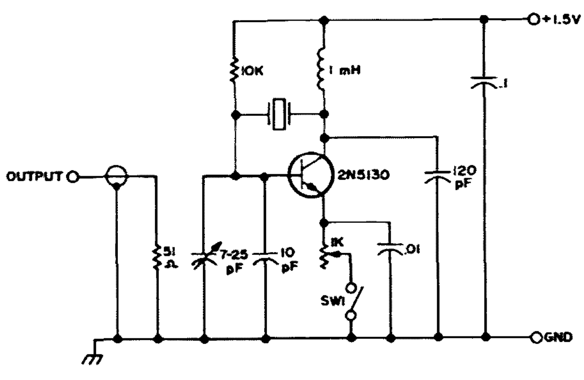

Fig. 1. Schematic diagram of the "Point Eight" Signal Source, the "poor man's Model 80."

The unit consists of a single 2N5130 NPN transistor oscillator configuration. Other transistors, such as the 2N706, can be used in this circuit with slightly different biasing arrangements; however, the 2N5130 appeared to give the cleanest output signal.

Output level can be varied from less than 80 nV (the best we could measure) to 50 mV. It is controlled by a 1 kΩ pot in the transistor collector circuit. Power is obtained from a 1.5V penlight cell bypassed for rf by a 0.1 μF capacitor.

My present "0.8" signal source has been used intermittently for more than a year without any degradation of output. However, remember to shut the unit off when you're finished with it; the battery doesn't last forever.

The unit is built on a PC board. The parts layout is almost exactly the same as that of the schematic shown in Fig. 1. The electronic components are placed on the copper side of the board. The on-off switch-level control, frequency adjustment, output jack, and crystal socket are on the other side (Fig. 2). The unit can be packaged in a minibox.

Almost any crystal in the 1.8–12 MHz will oscillate in this unit. The output is rich in harmonics to 450 MHz, so you can tune up any receiver from 160 to ¾ meters.

The output impedance of the signal source is 51Ω, a value which simulates a perfect antenna load to the receiver. This is the manner in which this is accomplished: A 51Ω, ½W resistor is connected across the terminals of an RCA phono jack. No physical connection is made to the circuit except through the common ground of the PC board. The maximum output level depends on the lead lengths of the resistor. (The unit has plenty of output when the lengths are about ½ in. long.) This design has an added safety feature, too; if by accident you load a

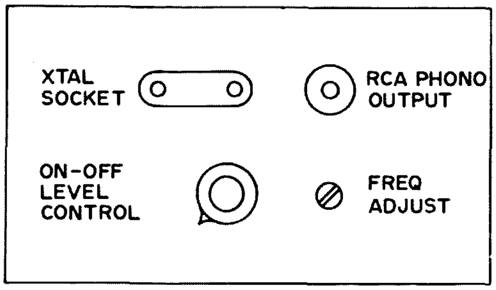

Fig. 2. Minibox layout of the signal source panel.

transmitter into the unit, all that is destroyed is the ½W resistor.

Operation and Uses

These units were originally designed to tune up 2m FM receivers. The procedure is quite simple. You connect the signal source to the antenna input on your receiver. Plug in a transmit crystal, and adjust the frequency control for a zero reading on the discriminator. Adjust the output level to the desired signal strength (below first limiter saturation) and tune up the receiver.

There are a myriad of other uses for the signal source. Using a 3.5 MHz crystal, you have a band edge marker. With the transmit crystals on a Twoer or any other transmitter you have instant frequency spotting without modifying the circuit of the transmitter. Of course, the signal source can be used to tune up any receiver, peak tuned circuits, be an rf source for an antenna noise bridge, and so on.

How to Get Yours

There are two ways to get the 0.8 signal source. The first is to make your own. If you have a well stocked junkbox, I suggest you do this. The second method is to take advantage of our club's assembled, tested, and guaranteed signal sources. By virtue of free labor, volume purchasing, and free parts donations from hams who are big wheels in their respective companies, we are able to produce the units for $8 postpaid anywhere. The units are available from the Toronto FM Communications Association, Box 427, Willowdale, Ontario, Canada.

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even more on touchtone

Touchtone has become very popular lately for a variety of signaling applications. FM repeater users, for example, have found this to be a particularly useful means for controlling a variety of repeater functions as well as for dialing through an autopatch.

The basic sending units, or pads, as they are commonly called, and decoders are available not only through surplus channels, but can be purchased new at prices which are reasonable for most hams' pocketbooks. One source of new pads is Automatic Electric Co. of Northbrook, Illinois. Their Touchtone pads are available in single lots for approximately $25. Touchtone signaling is also used for many computer and data transmission applications, and already some equipment from these fields is becoming available through the surplus channels.

Once you get a Touchtone pad, however, either new or surplus, the next problem is how to hook it up. The majority of pads available have been designed for telephone use, and have an overabundance of lead wires. Depending on the type you get, there may be 7 to 11 leads coming out of it. The number of leads, incidentally, has no relation to the number of buttons on the pad. Some of these leads are used in a telephone set to short out or attenuate signals to and from the handset through a set of switch contacts on the pad. Also, since the induction coil in the telephone set is sometimes used as part of the connection, there are even more leads to contend with.

It is possible to make a pad work with only two leads, plus and minus. The schematic of Fig. 1 shows one such connection scheme that I have successfully used on an Automatic Electric pad. It is my understanding that the Western Electric and Automatic Electric pads are identical in their external connections. When connected as shown, the pad will work with as little as 3V applied. The leads shown are the only ones of importance, and if your pad has other leads which are not shown on the schematic, they can be ignored. One exception would be if you have a violet lead and a green-white lead on an 11-lead pad; these are connected to an internal set of normally open contacts which close whenever any button is depressed. These leads can be used to key a push-to-talk, battery, or other line. With the hookup of Fig. 1, the Touchtone pad can be plugged directly into a carbon mike input circuit, and it will work without any other power requirement, since the microphone current source will usually be sufficient to power the pad. With a dynamic mike or crystal mike input, however, an external power source, load resistor, and blocking capacitor must be used, as shown in Fig. 2.

How about testing one of these pads, now that you have it working? Well, if you happen to live in an area where the phone company offers Touchtone service (even if you don't have this service yourself), then your local phone company probably has a device available that you can use. First, hook the leads on the pad together per Fig. 1. Then dial up the

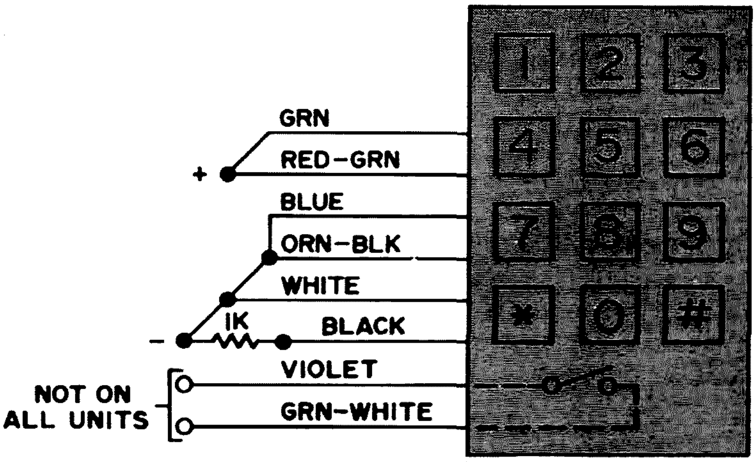


Fig. 1. Two-wire conversion.

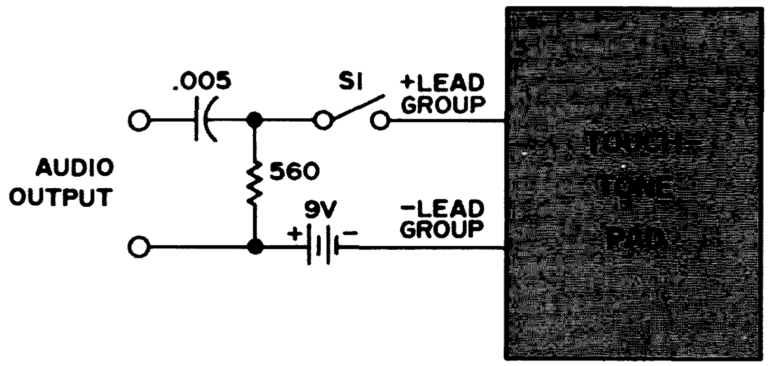


Fig. 2. Connections for use with non-powered mike inputs. S1 may be internal switch through violet/grn-wht leads if provided. Otherwise S1 is external SPST power switch.

ringback number for your phone. In many parts of the country, this number is 981- or 982- plus the last four digits of your own phone number. For example; your phone number is 234-5678 – the ringback would be either 981-5678 or 982-5678. You will get either a busy signal (in which case try the other prefix) or a second dial tone. If you get the second dial tone you have been successful in reaching the Touchtone tester. Being sure to observe the proper polarity, connect the pad directly across the phone line (red and green wires) and depress 1 through 0 in sequence. If the frequency and level of the tones reaching the central office are within the acceptable limits, you will be rewarded with two short bursts of tone. If they are incorrect, or you missed any one of the buttons, after 15 seconds you will hear one short tone burst. With a twelve-button pad, the test sequence is still the same. The # and * character buttons may be depressed, but they will not affect the outcome of the test. The dial tone will remain on during the entire test, so don't be misled by the fact that it does not go away after you depress the first digit button. Also, don't be disappointed by the fact that you can't use the Touchtone pad on your phone to dial; you can't unless the central office equipment has a Touchtone decoder for your line. Be sure to disconnect the pad from across the line *before* you hang the phone up as the line voltage will rise to 48V with the phone on the hook and could damage the pad.

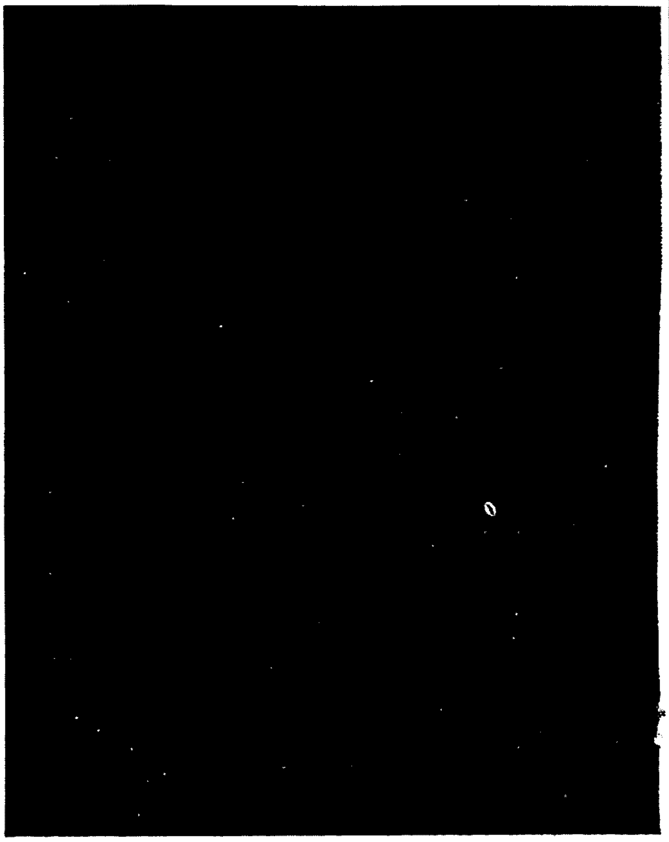
This ringback number is also used by telephone installers to make a phone ring back. If you should depress the hookswitch momentarily or dial a 1, a second dial tone will change to a 1000 Hz tone, and another dialed 1 or hookswitch depression will cause the phone to ring when it is hung up. In case the 981- or 982- prefixes do not work in your area, a call to repair service or a talk with an amiable telephone installer could probably get you the information required in order to access the ringback and test number.

. . .W1IRH

There are many receivers now on the market and a great many used receivers that can have their performance improved significantly by the addition of a preselector. Such receivers are the ones to which a beginner is attracted by consideration of price.

These receivers usually share such characteristics as lack of stability, lack of selectivity, and lack of ability to reject images. (Sometimes this last-named characteristic is linked to a high inherent noise level.)

Stability usually is a matter of basic electrical and mechanical design and is not often amenable to corrective measures. Sèlectivity sometimes can be enhanced by the addition of a Q-multiplier or a crystal receiver. By using solid-state active components, a preselector can be constructed as a single, self-contained unit. Such a unit can be added to a receiver without modifying or in any way lessening the resale value of the receiver, an important consideration for one who intends to upgrade his station equipment by swapping or trading in.



A SOLID-STATE PRESELECTOR

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What is desired of a preselector? Here are 10 points I believe to be pertinent:

1. Selectivity for rejection of images (not necessarily for rejecting adjacent-channel signals).
2. No gain. Even a small loss would be acceptable. Too much gain could degrade the cross modulation of the intermodulation characteristics of the receiver.
3. No increase in cross modulation, intermodulation, or noise.
4. No instability.
5. High tolerance of impedance match, both for the input and the output circuits.
6. One control; single tuned circuit.
7. Simple construction.
8. Low construction cost.
9. Parts readily available.
10. Capable of operation from a self-contained power supply.

With these requirements in mind, I built a preselector. I wish I could say I designed it and then put it together and had it work perfectly the first time power was applied.

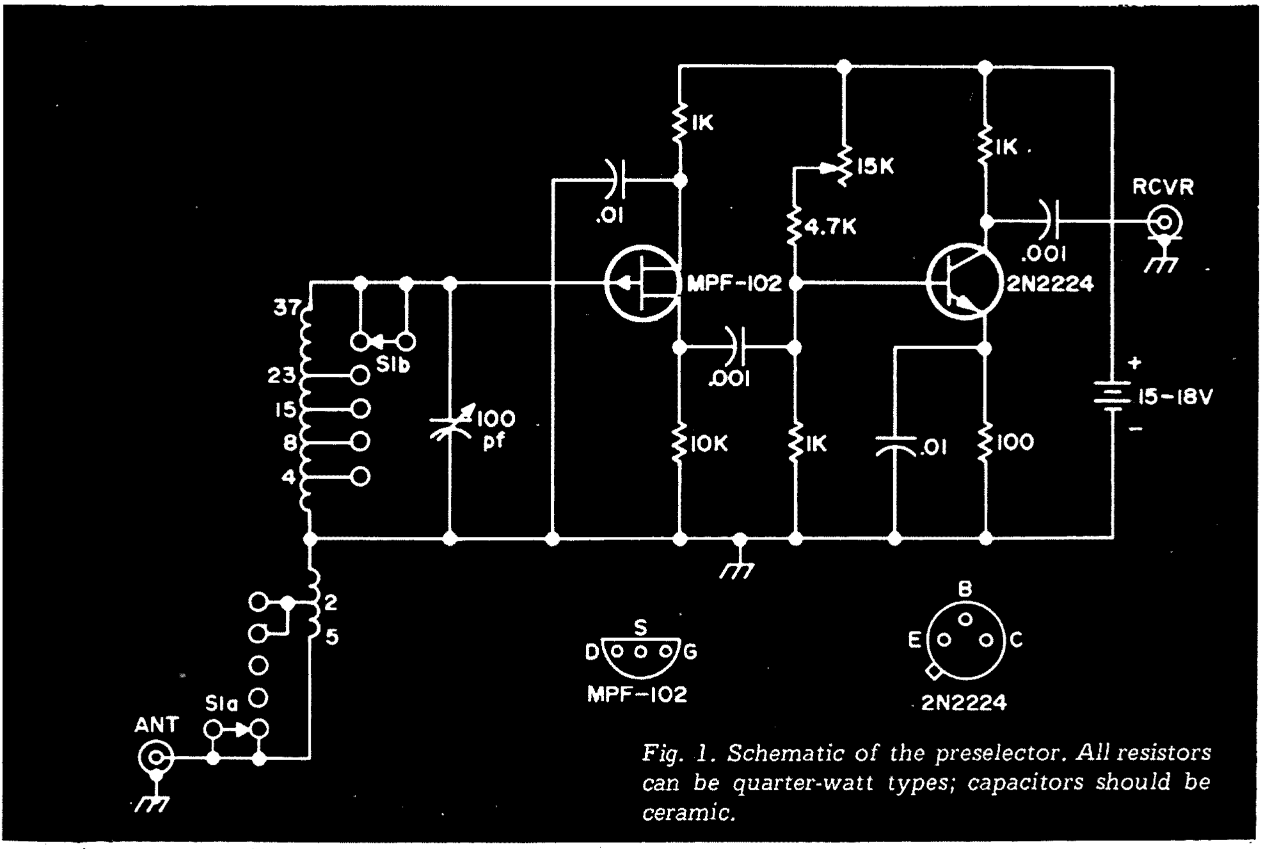


Fig. 1. Schematic of the preselector. All resistors can be quarter-watt types; capacitors should be ceramic.

But the fact is, I learned several new things and unlearned several things I'd previously considered to be factual! But isn't that the essence of amateur radio?

The unit was needed for use over the whole high frequency spectrum; that's why tapped coils are used in both the antenna and the tuned circuits (Fig. 1). High input impedance (for best selectivity) and freedom from cross modulation and intermodulation indicated the use of a field-effect transistor; using a junction FET as a source follower further enhanced these desirable characteristics. Isolation from reactive effects required the use of a low-gain, ultra-stable stage coupling the source follower to the output.

As mine was an experimental unit, I used perf-board and mounted all components on that. You may elect to put it into a cabinet and mount the tuning capacitor and band switch on the panel, a much neater way of doing business.

You can wind your own coil quite easily, using one of the popular plastic pill boxes for a form. I used a piece of Air Dux 832 T coil stock. It's 1 in. diameter and has 32 turns per inch – also, it just happens to be the right size to make a firm pressfit into the top of one of those pill containers, a very convenient way of mounting the coil upright. Five turns up from the bottom, I cut the wire and left a one-turn gap before the start point of the secondary portion. The primary is tapped two turns ftom the cold end (the end nearest the secondary); this tap is used for the two highest tuning ranges. The secondary is tapped (from the cold end) at 4, 8, 15, and 23 turns; it has a total of 37 turns. Don't take these figures as sacrosanct; stray values of inductance and capacitance can affect them markedly.

The band switch is a two-pole, five-position rotary switch, mounted for short leads to the coil and to the variable capacitor. Note that two of the primary switch points are left unused. Nothing is served by altering the primary turns in small steps.

The tuning capacitor is a two-bearing job, quite sturdy. It measured 100pF fully meshed, and minimum capacitance is 10 – 12 pF.

Nothing is unusual about the MPF-102 junction FET. There's a 1 kΩ decoupling resistor in the drain circuit to encourage rf to use the 0.001 μF capacitor as a path to ground. Coupling from the source to the NPN bipolar transistor is through a 0.001 μF capacitor.

You may be astonished at the low values of the base-to-ground resistor and the collector load resistor. These were selected to keep gain low and stability high. The gain can be controlled (at the expense of stability) by the 15-kΩ variable resistor in series with the 4.7-kΩ resistor used for applying positive bias to the base. It's best once set and then forgotten. In the emitter circuit, there's a bypassed 100Ω current-stabilizing resistor, something I like to put into the emitter circuit of every bipolar transistor used.

Rf output is taken off the collector through a 0.001 μF blocking capacitor to a short piece of 50Ω coax.

You'll note there's no switching arrangement for disconnecting the preselector. I use RCA-type phono plugs on my receiver, so it was convenient to use a like system on the preselector. It can be detached in a moment . . .and there's no feedthrough problem!

A word about that bipolar resistor. You'll not find the 2N2224 listed in many supply houses, yet it shows up on surplus printed-circuit boards. That's where I got mine. It's good, although several other NPN rf transistors worked quite well, too. So don't get concerned about getting any particular type of transistor. If you can't get an MPF-102 easily, the Motorola HEP-802 is an even swap.

The preselector performs amazingly well. The tuning is sharp, so much so that a slow-motion dial might be a good investment. It's quite astonishing to note just how much of the "crud" that you thought was inherent to a band disappears when the preselector deletes images. I suspect, also, that some of the diminished noise is attributable to a reduction in cross modulation and intermodulation. Anyway, the effect is delightful. You'll be glad you built it!

W5JJ■

Roy E. Gould W5PAG
4748 DeBeers Drive
El Paso TX 79924

The Transistor 12 WATTER FOR 10

Transistors are now available at reasonable prices that can handle a fair amount of power, even at frequencies beyond the 10 meter band. The 2N2631 is one of these and it was used as the final amplifier in the rig described in this article. Input power to the final is about 12W on CW and when driven as a linear for SSB, an input power of about 8W PEP is possible with low distortion.

While 12W is not high power, it is more than the average transistorized rig is capable of running and is enough power to do a good job when the 10m band is open. I have worked fourteen Japanese stations on CW while running 12W input and two Japanese, one German, and one Italian station while running 8W PEP input on SSB. Also, I have had many solid QSOs with U.S. stations, mostly on the east coast and in the midwest with this rig. The antenna used was a two-element 10/15 meter quad, up about 15 ft.

The Circuit

The rig consists of three stages: input, driver, and final. The circuit is shown in Fig. 1.

The input stage operates either as a third-overtone crystal oscillator for CW or as a linear amplifier for SSB. The circuit was taken from RCA, who designed it to be the oscillator of a CB rig. The transistor is intended for CB use and the oscillator works well on 10 meters.

When used as an oscillator, a third-overtone crystal is plugged into the crystal

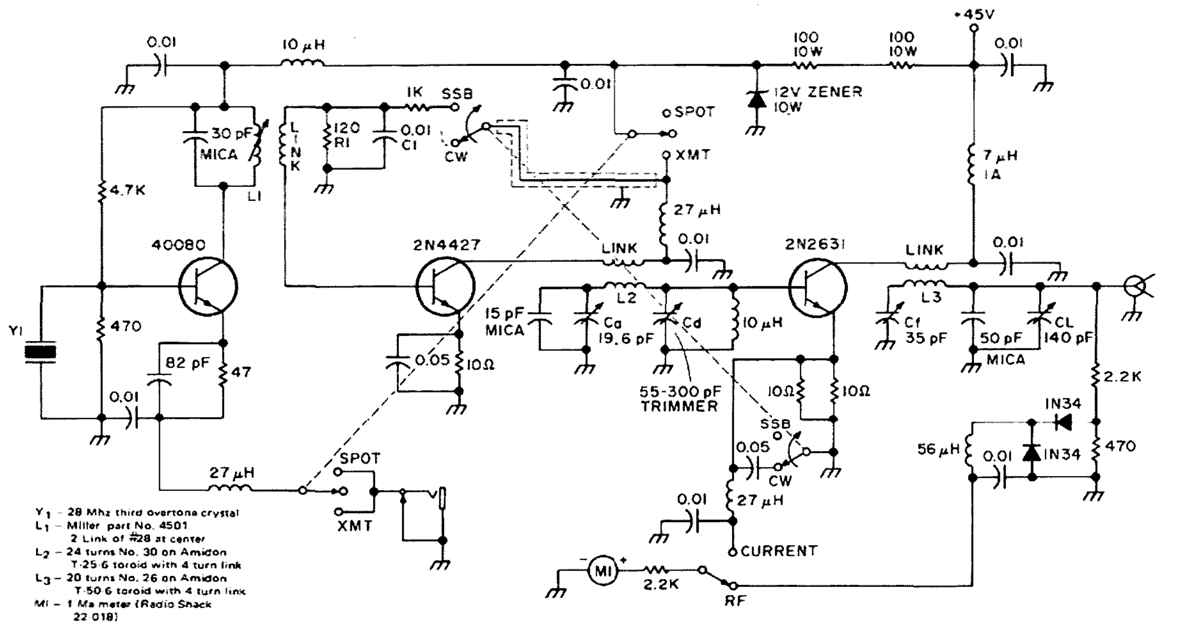
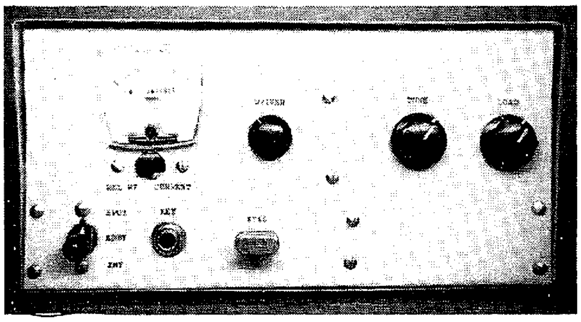


Fig. 1. Transmitter schematic.



Front view of the rig.

socket. The emitter circuit is keyed for CW operation. For use as a linear amplifier, the SSB signal is simply plugged into the crystal socket. No changes are required in the circuit itself. Less than 20 mW **PEP** is required to drive the input stage.

The driver stage uses a 2N4427 transistor, a high-gain VHF unit capable of 1W CW output at 250 MHz. This stage operates class C for CW amplification. The emitter resistor and its bypass capacitor produce the reverse bias needed for class C operation.

When used as a linear amplifier for SSB, forward bias is applied to the stage by switching the input bias resistor to the 12V supply. This allows the amplifier to operate class AB and makes the stage linear. It also reduces the gain of the stage slightly, but is necessary to obtain good linearity.

The driver uses an inductor input pi network as its tank circuit. This network tunes the output from the driver and matches the impedances between the driver and the final. It also provides a means of adjusting the drive to the final.

Both the oscillator and driver operate from a 12V power supply. This voltage is obtained by using a resistor and a 12V zener.

The final is biased for class C CW use by the voltage developed across the emitter resistor and its bypass capacitor. The final current is measured by reading the voltage across the emitter resistor.

When the final stage is used as a linear, the emitter bypass capacitor is disconnected, allowing the emitter resistor to introduce current feedback into the stage. Without this feedback the stage is quite nonlinear; however, with the feedback, it is linear up to a power input of about 8W. Introducing the feedback reduces the gain of the stage slightly but is necessary to obtain usable linearity.

The final uses an inductor input pi network as its tank circuit. This tank circuit can match resistive loads of 30–200Ω to the transistor. It uses a toroidal inductor and link coupling, and operates similarly to the conventional capacitor-input pi network, allowing a variety of loads to be matched.

The meter reads either relative rf voltage output or final current. The rf voltage output indication is used primarily when tuning the rig. If the final current meter is to be used to measure input power, it must be calibrated using another meter in the collector circuit between the power input terminal and the rf choke.

As shown in Fig. 2, the power supply uses two 24V filament transformers with the secondaries connected in series. The secondary voltage is rectified by four diodes in a bridge. The voltage is regulated by the transistor, whose reference voltage is fixed by the zeners. The output is filtered by the 2000 µF capacitor.

The power supply works well and the regulation is good. The no-load output voltage is 47V and the output at 1A is 43.5V. The ripple at this current is 1.4%.

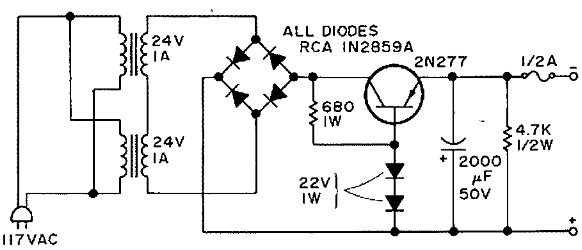


Fig. 2. Power supply schematic.

The construction of the power supply is not critical. The main problem is getting the secondaries in series so that their voltages add. If the voltage from the two secondaries is nearly zero, reverse the connections to one winding.

Construction

The rig, except for the power supply, was built on a 5¾ x 9 in. perf-board. An aluminum base (1½ in. high) was made

from sheet aluminum and the perf-board bolted to it. A front panel was made and fastened on with screws. An aluminum partition was used above and below the perf-board, between the final circuit and the rest of the circuitry for a shield. Some of the variable capacitors were mounted on the shield.

A wire was placed along and connected to the aluminum shield and used as the common ground bus. A single ground connection to this bus was used from each of the three sections of the rig. This was done to minimize ground loops.

The driver and final transistors were mounted on heatsinks made from sheet aluminum. The driver heatsink is 2¼ in. square with a ½ in. wide mounting flange on the bottom. The final heatsink is 2½ x 3 in. and also has a ½ in. mounting flange on the bottom. The transistors were mounted by passing their leads through three small holes in the heatsink. A piece of aluminum (1 x 1½ in.) and two screws were used to hold the transistor against the heatsink. Heatsink compound (silicone grease) was used to obtain good thermal conductivity.

No electrical insulation is needed between the heatsink and the transistor because the heatsink is bolted to the perf-board, which provides electrical insulation. A three-terminal strip was mounted on the heatsink and the transistor leads connected to it to provide convenient tie points.

The input stage was built close to the front panel to minimize the length of wire between the crystal socket and the base of the input transistor. The circuits were built using perf-board pins and each circuit was kept as compact as possible.

The "linear/class C" switch should be a rotary type and it should be placed as close as possible to the final transistor emitter resistors to minimize wiring inductance, since the gain of the stage is very sensitive to inductance in the emitter circuit.

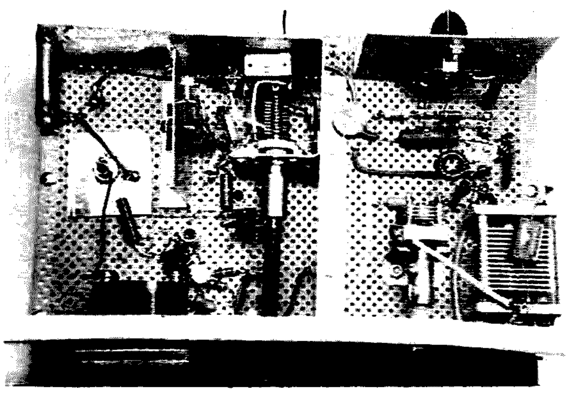
If the rig is to be used exclusively for CW or as a linear, the switch may be left out and rig wired for only the use intended. If the rig is to be used for CW only, R_1 and C_1 may also be left out and the link connected directly to ground.

Tuning Up

A 45V supply capable of a current output of at least 500 mA is needed to power the transmitter. After the power supply, dummy load and key are connected, turn on the power supply and place the mode switch in the spot position. Insert a third-overtone 10m crystal and close the key. While monitoring the operation of the oscillator with a receiver, adjust the inductor in the oscillator tank until strong stable oscillation occurs.

Now place the mode switch in the transmit position and momentarily close the key. Notice if there is any indication on the rf output meter. If not, adjust C_a until an indication is obtained on the rf output meter and then tune C_f and C_L to obtain maximum rf output. Then alternately adjust C_a and C_d in the driver tank circuit to obtain maximum rf output. The rig should now be close to the best tuning, but additional tuning of the oscillator inductor and the driver and final tank capacitors may result in more output.

Care should be exercised not to drive the final to an input of over 14W. This was not possible with my particular circuit, but might be possible if your transistors have higher gain than the ones I used.



Top view of the wiring; note the heatsinks and the shield between the final and rest of circuit.

On SSB, drive is connected into the crystal socket. The SSB signal can come from any available source. I used an HW-100 as the source of the SSB signal. The HW-100 was connected to a 50Ω dummy load and the drive signal taken from the dummy load. The method is shown schematically in Fig. 3. Using this setup, a relative rf reading of S-6 on the HW-100 drove the linear to 8W input.

After the initial tuneup, the rig can be tuned for SSB operation on the desired frequency by first applying a low level CW signal to the input and tuning the driver

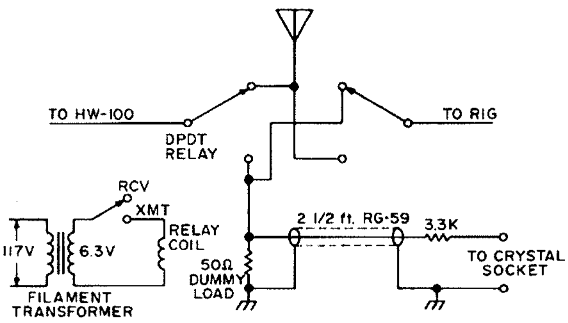


Fig. 3. Method used to obtain SSB drive from the HW-100.

and the final capacitors for maximum rf output from the final. Then apply enough drive to produce 8W input and retune for maximum output.

The CW output level from the HW-100 is not the same as the SSB output level at the same setting of the drive control. Therefore, after tuning the linear using CW, it is necessary to adjust the drive on SSB. This is done with the mode switch of the HW-100 in a SSB position by first turning the drive control completely down. Then while whistling into the mike the drive is turned up until full input (8W) to the final is obtained. The rig is then ready to operate on SSB.

Final Comments

This little rig does a surprisingly good job on both CW and SSB. I have had many solid contacts with it and have encountered several operators who found it hard to believe my power was this low. Incidentally, I thought I was doing well to work out with this little rig when I worked a station on CW in Liverpool, N.Y. who was using 182 mW input and 100 mW output. He was not very strong but perfectly readable. Low power is often sufficient on 10m, and this rig can do a good job for you.

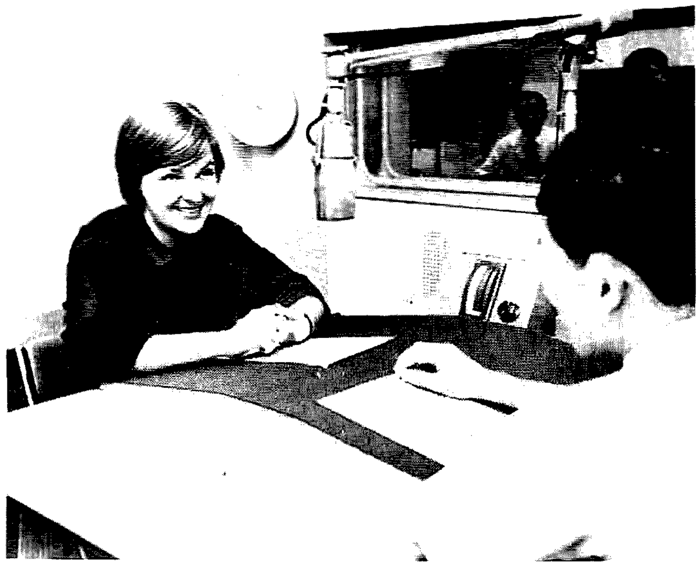
. . . W5PAG ■

A SLICE OF NIPPON CULTURE *through* *RADIO*


Main editorial room of Radio Japan.

If you've packed away your old Hallicrafters or Hammarlund receiver, there's a pretty good incentive now to dig it out. There's a whole lot of fun stuff goin' on.


Editors prepare copy for programs in some of the 23 different languages in which Radio Japan broadcasts.


Swedish-speaking announcer on the air with Radio Japan's Scandinavian service.

Just as millions of Japanese TV viewers nightly delight in watching imported American programs like *Lassie, Perry Mason, The Beverly Hillbillies,* and *Mission Impossible* (all dubbed in Japanese), more and more Americans are tuning in on the upper end of 20m to learn about Japan, savor the delicate sounds of Japanese music, and struggle with Japanese language lessons.

It's all brought to them by *Radio Japan*, the overseas broadcasting service of NHK, Japan's public radio and TV network. According to the Japan Trade Center, New York, NHK provides the service as a way of promoting friendly relations between Japan and the people of other countries. The initials stand for Nippon Hoso Kyokai, or Japan Broadcasting Corporation.

Far from being limited to Japanese residents abroad, *Radio Japan* broadcasts in 23 different languages and is heard on every continent of the globe. Anyone with a shortwave receiver equipped with four or more bands and a frequency range of up to 21 MHz can tune in.

The *Radio Japan* staff is well sprinkled with editors and announcers from many of the countries the programs are beamed at. With their Japanese coworkers, they pro-

duce informative features on Japan, musical varieties, news and commentary, as well as aural instruction courses in Japanese.

The news and commentary segments account for more than half of all programming. Features attempt to introduce and interpret Japan from all angles — sociological, economic, and cultural. Music ranges from traditional Japanese and other Asian strains to present-day pops of both Japan and the West.

Proof of *Radio Japan's* growing audience is found in the stacks of mail that NHK receives, the Japan Trade Center relates. About half a million cards and letters from enthusiastic listeners all over the world arrived at the studios in Tokyo last year, the Center says.

Staff workers examine latest collection of picture postcards received from Radio Japan listeners on six continents.

The mail indicates that listeners fall mainly into three categories. There are those who have lived in or visited Japan and like the feeling of nostalgia the programs bring, as well as the chance to keep up with current developments. A second group consists of those who simply have an interest in Japan and find the news and features an indispensable source of information and enjoyment.

The third category is made up of a growing number of people — especially in the United States — who use *Radio Japan* to learn or brush up on the Japanese language. One reason for the great popular-

ity of *Radio Japan's* language instruction programs is thought to be the fact that teachers of Japanese are relatively scarce abroad, while more and more people are becoming interested in Japan and in learning the language.

Two instruction courses are offered weekly. "Let's Learn Japanese" is for beginners, who may later progress to the advanced course, called "Let's Practice Japanese." Free textbooks accompany the courses and are sent to listeners who write in for them.

Programs beamed to New England and the East Coast begin at 6:45 p.m. nightly, at 17.825 or 15.445 MHz. This is one of nine regional services broadcast in local languages for one or two hours a day.

Souvenir pennants are especially prized by young listeners of Radio Japan. Many join Radio Japan fan club, which has 30 chapters around the world.

In addition, *Radio Japan* broadcasts news and commentary in English and Japanese every hour on the hour worldwide at a number of different frequencies. These transmissions have a duration of either one half or one full hour.

New listeners especially are urged to report the fact that they have heard *Radio Japan* by writing in to NHK. In return, they will receive an official verification card, handsomely styled in the Japanese manner. The address is *Radio Japan* NHK, 2 Uchisaiwai-cho 2-chome, Chiyoda-ku, Tokyo, Japan.

TESTING THE

After looking once at the Ten-Tec RX-10 receiver, you'll ask, "Where's the bfo?" You won't find it; SSB and CW tune just like AM – no bfo, no switching from mode to mode – just tune the station in and peak the antenna trimmer. That's all.

The RX-10 is a solid-state, four-band receiver of surprising and impressive quality. For those of you who have read the articles that have appeared describing the direct-conversion system* of detection and wondered whether to homebrew and experiment with the circuit, you won't need to. The Ten-Tec RX-10 sports a commendable commercial version of the circuit.

In the direct-conversion or "synchrodyne" receiver, the incoming signal is mixed with a signal from a local oscillator so that the difference of the two frequencies is a frequency in the audio range. Eliminating any i-f stages or conventional detector stage, the signal is then passed through an audio amplifier and the desired selectivity is achieved through audio filters rather than through Q-multipliers, crystal filters, or other radio frequency devices. Because the incoming rf signal is immediately converted to audio, no bfo is necessary for SSB or CW reception.

Right out of the packing box, the RX-10 can be run either from 12V dc or regular 120V ac without the need for any external inverters or power supplies.

TEN-TEC RX-10

Aimed at the portable enthusiast and the Novice, the RX-10 is designed for headphone operation and does not include a built-in speaker. This is no disadvantage to the ham working through Novice QRM or the distractions of portable operation. (Whoever heard of a brasspounder not using cans, anyway?)

There is plenty of audio gain with the RX-10, and the sensitivity is astonishing. Tuning is easy, with pushbutton band changing, and the rig has a jack for a key (the RX-10 has a built-in code practice oscillator and CW monitor, too).

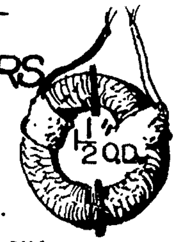
While not a DX or contest performance receiver, the RX-10 might seem the answer to the prayers of many a brasspounder who has wanted a truly portable CW receiver. Small, lightweight, solid-state, and needing only cans and a hunk of wire to pull in the signals, the RX-10 can provide plenty of signals to copy.

This little receiver definitely should silence the skeptics who have questioned the practicality of the direct-conversion receiver. Here is an attractively packaged, truly portable receiver which outperforms the simple, regenerative portable designs and definitely challenges the heavier, bulkier, multitube "simple superhets."

You'll probably not work the world with the RX-10, but you will hear enough stations for many pleasant QSOs whether at home or on the road. For those Novices or confirmed old brasspounders who envy those VHF'ers with their hand-held units, the commendable performance-to-weight ratio of the RX-10 may start a flurry of homebrew and commercial activity towards making HF CW more portable (and more popular). All we have to do now is figure out some way to make an efficient 80 meter whip about 19 in. long.

. . .WB2MYU

See, for example, "Direct Conversion – A Neglected Technique," Hayward and Bingham, QST, Nov. 1968.



GETTING FOR

Dennis McCarthy K0YTI
5022 Lansdowne Avenue
St. Louis MO 63109

DX Editor Dave Mann recently said he could "cite example after example" of hams who have aided in various emergencies. "Yet the newspaper coverage in these situations has been minimal or nonexistent altogether," Dave notes.

As a newspaperman for some 12 years, I can attest to Dave's observations. But the blame should not be placed on the newspapers. With the exception of releases from MARS, there has yet to be one story formally submitted to The St. Louis Globe–Democrat by a radio amateur during the past 12 years, save for those personally written by this reporter!

There is no trick to getting publicity for your amateur radio activities. I can assure you, editors welcome news that is different from the day-to-day carnage and gloom they print. There are some common-sense rules in getting publicity. To publicize routine activities you should:

ONE – Submit a written release. Don't call the newspaper and try to tell the editor the story over the phone.

TWO – Submit the release well in advance.

THREE – Have all the details in the release, including where the sender might easily be reached.

FOUR – Try to have the story "break" at a time most convenient to the newspaper. Space is at a premium. However, a newspaper usually has more room in its Sunday or weekend edition.

FIVE – A *very* local story might be discarded by the metropolitan paper, but be much in demand by the editor of a neighborhood newspaper, so don't forget to send him a carbon.

SIX – And as long as you're making carbons, send copies also to radio and television stations. Media editors "log" such releases and you might be surprised to

PUBLICITY HAM RADIO

see sound-on-film crews show up at your next hamfest!

SEVEN – Remember that the average reader does not understand technical and abbreviated terms such as RTTY, CW, SSB, etc. Keep it simple, yet interesting and informative. For example: "Single Sideband – the type of radio telephone communications used by astronauts as well as amateur radio operators – will be the topic of discussion at the Podunk Amateur Radio Club Meeting Tuesday, June 30."

Note the reader now has probably been introduced to the term "single sideband" for the first time. He paid attention because he could relate the term to something he is somewhat familiar with, astronauts and moonshots. As a result, his (and the editor's) attention was gained. The story was printed and read.

EIGHT – If a release is printed, drop a line to the editor thanking him for his help. If there is a feature on ham radio printed, again write and tell the editor how much you enjoyed it.

NINE – If you have an unusual feature and a reporter is assigned to the story, don't think you're doing him a favor by giving the story to him. He gets paid by the hour – not the byline.

TEN – All the above applies to *routine* stories and releases. However, should a disaster occur and your radio club become involved in emergency communications, call the newspaper and radio and TV stations immediately. Again, if you call a day or two later, it's "yesterday's news."

There have been many times that amateur radio was the only source of information to the public. That information cannot be disseminated, however, if the newspapers, radio, and TV don't hear of it.

. . . KØYTI ■

73 Reader Service Coupon

Now we don't say that every single reader must buy every last product advertised in 73. We believe that, but we don't say it. The very least every reader can do is to put on a show of interest in the products herein advertised. To make this a simple task, even for the laziest reader (now there is a contest for you!), we have cleverly arranged the advertising index to double as a readers service coupon. All you have to do is tear it out (or photocopy it) and send it in with the appropriate boxes marked. (We have a prize for the most boxes marked . . . a silent prayer of thanks from the publisher). We'll accept postcards, slips of paper, or almost anything else that lists the companies you want to hear from and your address.

No one likes to go into a store without buying something, right? It is the same with these information requests. You will be expected to buy something. Oh, it doesn't have to be a $50,000 antenna system, but it should be something modest . . . a transceiver . . . a linear . . . you know. We'll leave the decision up to you, knowing that we can trust you to do the right thing.

And we are definitely not saying that the use of this service coupon has any curative powers, but we cannot but notice that many readers report remarkable relief from simple backache, headaches, lumbago, and acid indigestion after sending in their coupon. Why take any chances?

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HAWAII	21A	21A	21	14	14	14	7	7	14	21	21	21A
INDIA	14	14	14	7B	7B	7B	7B	7B	14	14	14	14B
JAPAN	21	21	21	14	7B	7	7	7	7	7B	14	21
MEXICO	21	21	14	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	21	21	14	7B	7B	7B	7	14	14	7B	14A
PUERTO RICO	21	14	14	7A	7	7	7	14	21	21	21	21
SOUTH AFRICA	14	14	7	7B	7B	7B	7B	14	21	21	21	21
U. S. S. R.	7B	7B	7B	7	7	7B	7B	7B	14	14	7B	7B
EAST COAST	21	14	7A	7	7	7	7	14	21	21	21	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

AMATEUR RADIO 73

#128
May 1971
One Dollar

- 75 m Mobile Antenna
- 10 m DSB Transmitter
- 450 MHz "Remote" Transmitter
- Transistor LM Freq Meter
- 2m FET Preamp

73 MAGAZINE

#128 May 1971

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STAFF

73 Magazine is published monthly by 73 Inc, Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas, $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough, N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. Entire contents copyright 1971 by 73 Inc., Peterborough NH 03458. Phone: 603-924-3873. We don't wish to cause any alarm, but reports of great disasters have been coming in from 73 readers who have permitted their subscriptions to lapse. Why take chances?

On the Cover:

DLØSTA, Germany's first 2m FM repeater atop Stuttgart's famous Fernsehturm.

Amateur Radio News Page

April MCMLXXI — Monthly Ham News of the World — 73 Magazine

FCC PROPOSES NEW EXPANDED PHONE DANDS

The FCC has just released its long-awaited proposal to expand the high-frequency phone bands. The move came after many long months of poring over petitions, proposals, and comments submitted by interested amateurs and groups. The petition, if passed without change, would mark the amateur's first move into a licensing system that is truly based on "incentive" rather than "punishment."

FCC Secretary Ben Waple said, "The Commission believes that some expansion of the . . . telephony subbands is desirable." He stated that an exclusive 25 kHz segment of each phone band would be set aside at the low end for Extra class use. In justifying this, he added, "The modest number of U.S. licensees of this class should not significantly affect foreign telephony operation therein and the greater possibility of . . . (working DX) should be an incentive to qualify for the Extra class license.

With the exception of the 7 MHz band, expansion of each of the current Extra/Advanced reserved subbands is proposed. Expansion of current General/Conditional subbands is proposed in four bands. Expansion of the 28 MHz phone subband to provide a similar pattern of Extra and Extra/Advanced phone subbands is also being proposed by the Commission. Appropriate modification of the 7 and 21 MHz Novice subbands is included. A 28 MHz Novice band is being proposed as compensation for the proposed reduction in the 21 MHz Novice spectrum. Because of the light occupancy in the current 25 kHz

General and Conditional: All authorized amateur privileges except those exclusive frequency operating privileges which are reserved to the Advanced or Extra class but including operating privileges in the 7075–7100 kHz band with telegraphy, and with telephony when located outside Region 2.

Novice: Those amateur privileges designated and limited as follows:

Radiotelegraphy is authorized in the frequency bands 3700–3750, 7100–7150 (7050–7075 when located outside Region 2), 21100–21200 and 18150–28250 kHz, using only type A1 emission and 145–147 MHz, using radiotelegraphy emissions as set forth in § 97.61.

Amateur Extra and Advanced: All authorized amateur privileges including exclusive frequency operating authority in accordance with the following table:

Frequencies	Class of license authorized
3500-3510 kHz	
3750-3775	
7000-7010	
7150-7175	Amateur Extra Only
14000-14010	
14150-14175	
21000-21010	
21200-21225	
28350-28375	
3775-3875 kHz	
7075-7100	
7175-7225	
14175-14250	Amateur Extra and Advanced
21225-21325	
28375-18500	
50.0 - 50.1 MHz	

Pacific Coast Hams Get Shifted

Parts 2 and 97 of the Rules dealing with the sharing of the 1800–2000 kHz band by the amateur radio service has been amended by the Commission to modify the availability of the frequencies for use by the amateur service on a shared basis with Loran stations. The action becomes effective April 13, 1971.

The Commission action was in response to notice from the Coast Guard that certain changes in the Loran-A radionavigation system are necessary for implementation by May 1, 1971.

Parts 2 and 97 permit the amateur service to use the band on the basis that it shall not cause interference to the Loran-A radionavigation service, that it shall not be a bar to the expansion of Loran, and is "subject to cancellation or to revision, in whole or in part, by order of the Commission without hearing . . ."

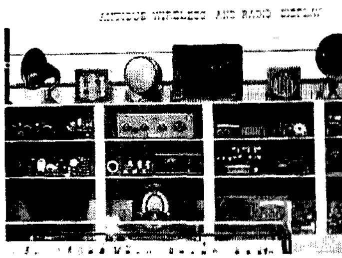
The changes provide modifications in the Pacific Coast frequency segments to shift amateur operation from the higher frequency segments to the lower frequency segments.

LED Crystal Growth Development

Experimental gallium-phospide crystals have been grown for the first time at Motorola in Phoenix. Such crystals are the starting material for the fabrication of green light emitting diodes. A modified Czochralski technique is used to "pull" the crystals from a molten alloy of the two elements. High ambient pressure ($\approx$ 1500 lb/in^2) is required over the melt in order to compensate for the unequal vapor pressures of gallium and phosphorous. Without pressure, the phosphorous would rapidly boil off, and no useful crystals would be formed. The high pressure reaction chamber is housed inside a 10 ft diameter safety tank, and growth of crystals is monitored remotely on a TV screen. Establishing a high volume capability in the production of exotic materials such as gallium phosphide is a necessary part of Motorola's continuing expansion in the field of optoelectronics.

ANTIQUE WIRELESS and RADIO DISPLAY

A fine exhibit of antique wireless and radio equipment is on display at the Aerospace Museum, Balboa Park, San Diego, California. The members of the San Diego Chapter of QCWA, under the chairmanship of Jim Barth



W6KCO, have installed this unique display which should be of interest to the general public and educational for the many school children who visit this fine museum. Things of interest include a display of early radio tubes from land, sea and aircraft equipment and a model 1920 wireless station.

Hunger Hikes Need Hams' Help

On May 8 and 9, 1971, in more than 350 cities in the U.S. and 40 others around the world, millions of private citizens will be walking through their local communities in the certified record of the miles they walked.

In every Walk there is need for a communications network, preferably mobile, that keeps track of the Walk

Extra class CW segments, the FCC stated, reduction of each of these allocations to 10 kHz is proposed.

The specific rule changes proposed by the FCC are as follows:

Authorized frequencies and emissions

Frequency band, MHz	Emissions
1.800-2.000	A1, A3
3.500-4.000	A1
3.500-3.750	F1
3.750-3.875	A5, F5
3.750-4.000	A3, F3
7.000-7.300	A1
7.000-7.075	F1
7.075-7.100	A3, F3, Ab, F5
7.100-7.150	F1
7.150-7.225	A5, F5
7.150-7.300	A3, F3
14.000-14.350	A1
14.000-14.150	F1
14.150-14.250	A5, F5
14.150-14.350	A3, F3
21.00-21.45	A1
21.00-21.20	F1
21.200-21.325	A5, F5
21.20-21.45	A3, F3
28.00-29.70	A1
28.00-28.35	F1
28.35-29.70	A3, F3, A5, F5

SPECTRUM STUDY PLANNED

According to a recent article in *Electronics*, the FCC and the White House Office of Telecommunications Policy are about to disclose detailed plans for a study of the use of the radio spectrum. In preparation for the study, OTP has already asked the Interdepartment Radio Advisory Committee to prepare a statement on the nature and extent of the government's use of the spectrum. Since large blocks of frequencies are set aside for exclusive government use, the consensus is that the committee's statement could lead to provisions for nondefense agencies to share their frequencies with private users. The study is a part of a long-term program that should "lead to a more rational use of the frequency spectrum."

Radio Comes to Aid of Girl

Reprinted from Dallas Times Herald.

An emergency call from South America answered by a Dallas ham radio operator may save the life of a small Colombian girl.

"I feel she will be okay here in Dallas," said the mother of 8-year-old Monica Rosada who will soon be operated on in Dallas for a serious liver ailment.

Monica who may need a liver shunt operation checked into Children's Medical Center Tuesday after a 22,000-mile diagnosis.

It all began Sunday when ham radio operator John Adel intercepted a call for help from Barranquilla, Colombia. Monica was crticially ill and losing blood.

Her mother, Mrs. Mariela Rosada wanted to bring her to the United States for the needed operation.

"I was afraid to make the operation there," said Mrs. Rosada, "I was afraid of post operation. And somebody told me there was a good hospital here."

Thanks to Adel and medical personnel in the United States and Colombia, Monica arrived in Dallas Tuesday and had doctors and a hospital bed waiting at the Children's Medical Center.

Monicas family doctor sought a ham radio operator in the Dallas area to see if he could get in touch with a Colombia doctor he thought was in Dallas.

"Another ham radio operator called me Sunday," Adel said, "and asked me to help him with this call for help from Colombia. We took the call and got in touch with the doctor after finding out he was practicing in Wichita Falls now."

Then the ham radio operator got the two doctors together. They diagnosed the girl and decided she needed to be hospitalized immediately.

The Wichita Falls doctor then contacted another Colombia doctor in Dallas for him to make the necessary arrangements for Monica at Children's Center.

Dr. Carlos Esquiva, from a town only 100 miles away from the little girl's hometown made the arrangements. Dr. Esquiva, a resident at St. Paul Hospital, also was on hand to meet the youngster's airplane.

APOLLO LAUNCH PARTICIPATION WANING

The Cape Kennedy Amateur Radio Society conducted its special launch for the Apollo 14 mission on January 31, 1971, despite attrition of its members due to a layoff occurring at the Space Center. Approximately 500 calls were handled by the club members.

Founded about five years ago, the Space Center Amateur Radio Society at one point had as many as 40 members. At present the society is down to 8 members. During previous launch operations, as high as 2000 calls have been taken in the 24 hours following the launch. The peak was reached during the Apollo 11 launch. During the Apollo 12 launch they received approximately 1300 calls, about 900 were recorded for Apollo 13, and at this time about 500 calls for the Apollo 14 mission.

The reduction in the calls was not due to the number of amateurs attempting to contact the club station, WB4ICJ, but rather due to the fact that the club was down to only two transmitters on 20 and 40 meters, and the fact that they were reduced to four operators plus a visiting amateur who assisted.

largest constructive show of grassroots concern about the problems of hunger and poverty that the world has ever witnessed. In conjunction with the U.N. Food and Agriculture Organization (FAO), the American Freedom from Hunger Foundation (AFFHF) is sponsoring the International Walk for Development Weekend through the local organizing activities of its student Young World Development committees. Effective radio communications both within and among the individual Walks is essential for the safety and success of all the Walks. Hams nationwide are being asked to participate on the local level in this world-wide effort.

The Walk for Development is a program proven around the nation during the past five years in its capacity to raise funds for foreign and domestic self-help development projects. Moreoever, it is a good means to motivate a whole community into learning and doing more about the catastrophic problem that the malnourishment of one-half the world graphically represents. Whole communities are drawn together to cooperate in the effort, and, in the process, generation and apathy gaps are bridged.

A Walk works like this: a local group organizes itself to conduct a public information campaign – giving speeches, printing posters, distributing brochures – and to recruit Walkers. The local committee also maps out a Walk route – usually 20 to 30 miles long – that winds through the city or countryside. Each Walker is responsible for soliciting his own sponsors, each of whom pledges to contribute an amount of money – from a few cents up to a dollar or more – for every mile successfully completed by the Walker. On the day of the Walk, the crowd of Walkers begins early in the morning on its trek, hiking throughout the day; then they collect from their sponsors according to a along the route and handles all the traffic that deals in emergency and organizational information as well as information on food and medical supplies. Such a situation would probably be most effectively handled by a radio network of 2 meter FM mobile and based rigs in conjunction with a repeater. Where these are lacking, one could also use nets of 6m or 40m mobile rigs.

Beyond the individual Walk networks, there is another dimension to consider. A feeling of common effort is present among all those around the world taking part in that day; in a sense, however, the realization of this fact is largely limited to paper. Communications between the participants, both in the U.S. and in the rest of the world would really create a live experience of international unity, and allow the walkers to sense the dimensions of their present efforts and their future tasks. It would greatly enhance the Walks to have national and international radio communications between different Walks, and between the Walks and the projects they are supporting. People could exchange words of thanks and good will, send messages on the progress and outcome of certain Walks and sense a unity of common action.

In order to facilitate such a venture, it might be helpful for hams just to be listening to their sets when they have free time the weekend of May 8-9. From that net frequencies, controls and timetables will evolve as needed.

If you or your club are interested in helping out and wish more information about the Walks in your area, please contact Mike Donoghue, Maryknoll College, Glen Ellyn, Illinois 60137, (312) 469-4500, or Mary Ann Mason of the American Freedom from Hunger Foundation, 1717 H St., N.W., Washington, D.C. 20006, (202) 382-6727.

HAMFESTS and PICNICS

The Yellow Thunder Hamfest 71 will be held at the Dellview Hotel in Lake Delton, Wisconsin on May 23, 1971. Afternoon programs will include MARS, WATS ARPSC and others with a banquet in the evening. Tickets are $5 in advance or $5.75 at the door. For further information contact Kenneth A. Ebneter, K9GSC, 822 Wauona Trail, Portage, Wisconsin 53901.

The Wabash Co. ARC's third annual hamfest will be Sunday, May 23, rain or shine, at the Wabash Co. 4H fairgrounds. There will be activities for all including Bingo, Flea Market (no setup charge), repeater talks, film and slides, and an amateur television talk with demonstration. Food will be available. Admission is $1. For more information write Bob Mitting, 663 N. Spring St., Wabash, Indiana 46992.

38th ANNUAL WESTERN NEW YORK HAMFEST & VHF CONFERENCE, Rochester, New York, May 15th. Activities start Friday night followed by full day of programming with outstanding speakers. An added feature is the huge flea market covering an area of 6 acres. New location is Monroe County Fairgrounds on Rte. 15A near Thruway Exit 46. Send for map and program. Registration $2.75, Advance Dinner/registration $6.75 before May 10. Mail check to: R.A.R.A., Box 1388, Rochester, N.Y. 14603.

The 17th annual Breeze Shooters Hamfest will be held at White Swan Park, Parkway West near the Greater Pittsburgh Airport on May 23. This is the "largest" amateur event in the Western Pennsylvania area so plan to attend. Plenty of free parking, large amusement park for the XYL and harmonics. Talk-in frequency is 29.00 and 146.94. For additional details write D. J. Myslewski, K3CHD, 45 McMahon Drive, Irwin, Pa. 15642.

(winner takes pick). Bring your equipment to swap and auction (bring your own tables, pls). Pre-registration $1.00, regular admission $1.25. Pre-registration send to (or for more information): Art Hartwell, 2630 El Segundo Dr., Rancho Cordova, Calif. 95670. (916) 363-9225. Pre-registration deadline 8 May 1971. Playground area for children at park.

After an absence of several years, the Malden Amateur Radio Auction returns, sponsored by the Malden Amateur Radio Assn. This auction has always been one of the biggest and best in New England and now it will be bigger and better than ever.

The place – Same place, the American Legion hall on Pleasant St., Malden, Mass.

The time – Same time, eight o'clock in the evening.

The date – Saturday, May 22, 1971.

Terms – Same terms, we get 10%.

Refreshments of course. There will be the usual surprises and awards. Come early for a good seat. Please, we will not accept any floor sweep-ins. We reserve the right to limit the items of any one person. Tag and identify all your equipment. Low pressure auctioneer. Eli Nannis W1HKG.

The Birminghamfest this year will be on May 2 at the Armory on Oporto Avenue (just off U.S. 78 East – near Eastwood Mall). For entertainment, prizes, contests, net meetings, eyeball QSO's and fun for the entire family, plan to attend. For further information contact the Birmingham Amateur Radio Club – W4CUE, Box 603, Birmingham, Alabama 35201.

The Baton Rouge Amateur Radio Club will again hold their annual hamfest in Baton Rouge, Louisiana on the first weekend in May.

The festivities will start with a hospitality room Saturday afternoon at 1:00 p.m. at the Holiday Inn-

70th ANNIVERSARY OF OLD "CC" TO BE OBSERVED BY W-1-SS

The year 1971 marks the 70th anniversary of the start of construction of the old "CC" – the original Marconi station on Cape Cod, Massachusetts, where the first wireless messages between England and the United States were exchanged by President Teddy Roosevelt and King Edward VII of England.

Those stations desiring to work the site of the original Marconi station will find W-1-SS active on all bands from 160 Meters through 2 Meters during the DX hours for each band on the last weekend in April. Look for W-1-SS the Club Station of the Bedford Massachusetts Radio Club on April 24, 1971 and April 25, 1971.

Band	CW	Phone
160	1.801	1.805 MHz
80	3.580	3.935 MHz
40	7.100	7.260 MHz
20	14.050	14.315 MHz
15	21.100	21.375 MHz
10	28.100	28.700 MHz
6		50.200 MHz
2		145.100 MHz

Hey! Hey! Eligibility Period For Extra to be Cut

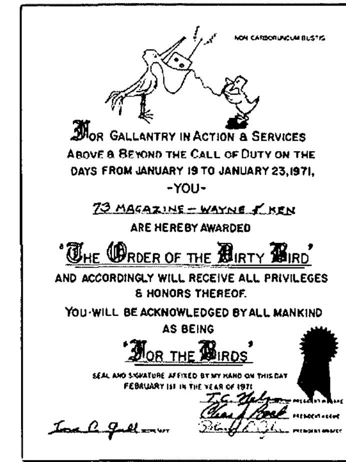
Reduction of the eligibility period for the amateur Extra class operator license from two years to one year has been proposed by the FCC in a rule making notice. The proposal would amend Part 97 of FCC rules (licensing and operating requirements for the Amateur Extra Class License). The FCC also proposed that holders of the amateur "Extra, First Class" license, issued between June 1923 and June 1933, receive credit for the 20 wpm code requirements needed to qualify for the present Extra class license.

OPERATION OILY BOID

In the foggy predawn hours of the morning, two oil tankers (one inbound, one outbound) collided near the Golden Gate Bridge creating one of the largest oil spills in recent years. In excess of 800,000 gallons of bunker fuel seeped out of the ruptured forward section of one of the tankers. The crude-like oil was rapidly carried into San Francisco bay by the incoming tide. Later, as salvage operations began, the tidal action went to work on the oil and reports soon came in that oil had spread along the bay waterfront in San Francisco, Sausalito, the Tiburon peninsula and Angel island. The outgoing tide carried the oil out to sea but evidence of the spill was appearing both north and south of the Golden Gate bridge at coastal beaches. As tidal action and ocean currents spread the oil to an ever widening area, reports were received that local water birds were in trouble. School children and residents were finding oil-soaked birds on beaches and taking them to the Richardson Bay Audubon Sanctuary for treatment.

The next day, bird salvage operations were in full swing at the sanctuary on the Tiburon peninsula and oil-soaked birds were being received in large numbers. Before long, local radio and TV stations were broadcasting requests for volunteers to assist in the bird-washing operation. Volunteers responded by the hundreds and soon bird-washing and treatment centers were established at Bolinas Lagoon, Richmond, Terra Linda and the San Francisco zoo in addition to Audubon headquarters in Tiburon. It looked like the birds had a chance and the concerned people of the Bay Area were working around the clock on "Operation Oily Boid."

As more and more volunteers appeared to help, it soon became evident that the already jammed



FOR GALLANTRY IN ACTION & SERVICES ABOVE & BEYOND THE CALL OF DUTY ON THE DAYS FROM JANUARY 19 TO JANUARY 23, 1971,

-YOU-

73 MAGAZINE – WAYNE & KEN

ARE HEREBY AWARDED

'THE ORDER OF THE DIRTY BIRD'

AND ACCORDINGLY WILL RECEIVE ALL PRIVILEGES & HONORS THEREOF.

YOU WILL BE ACKNOWLEDGED BY ALL MANKIND AS BEING

'FOR THE BIRDS'

SEAL AND SIGNATURE AFFIXED BY MY HAND ON THIS DAY FEBRUARY 1st IN THE YEAR OF 1971

expand and man the communications network.

Basic operation and traffic handling was coordinated on WB6AAE via the repeater. Additional coordination and organizational traffic handling was coordinated via WB6AAE's UHF repeater to allow 2 meters to handle only *Oily Boid* traffic. The coastal area in and around the bay is quite rugged and mountainous and although WB6AAE covers the area well, there were areas where communication was marginal. To overcome this terrain problem, the VHF Expeditionary Society activiated their own 2 meter repeater (K6GWE) and the two repeaters were tied together via a "human link." Stations on WB6AAE (2 meter FM), WB6AAE (UHF-FM), and K6GWE (2 meter FM) were set up at net control. Backup base stations were established in Oakland, San Francisco, and San Rafael to provide additional access to clear phone lines and handle overflow traffic.

In all, 65 amateurs from the three clubs spent a total of 922 hours providing FM communications during

The Fox River Radio League will have its annual Hamfest on August 15 at Phillips Park in Aurora, Illinois. Free coffee and donuts will be served from 9:00–10:00 AM. Advance tickets $1.00, $1.50 at the gate. Talk in frequencies 146.94 MHz and 3.94 MHz. For further information contact: Tom Rogers, WA9WBV, Box 323, Oswego, Illinois 60543.

Sacramento Valley annual ham get-together. Swap Shop – Eyeball QSOs. Sunday 15 May '71 – Carmichael Park. A joint presentation of the North Hills ARC, Sacramento ARC and the Rams. Visit the gang you rag-chew with and meet other hams. Special events for Novices and Old-Timers. Have your mobile rig and antenna analyzed by the RAMS. North Hills club will troubleshoot your equipment. Food and Refreshments – Coffee, hot dogs, soft drinks, suds, cookies, cake, etc. Two noted speakers: Oliver Swan and "Doc" Gmelin. Commercial exhibits and drawings every hour. Grand Prize: 3 el. beam or VHF beam

EIA 220 MHz Proposal Filed

The Electronics Industry Assn filed its 220 MHz proposal with the FCC in mid-February for the establishment of a new Class E citizens band in what has been an amateur band heretofore.

The details on the proposal appeared in the March 73 editorial on newspage six and pages 124-125-126 of the same issue. Where the 73 proposal for the band is based upon keeping it as an amateur band with the addition of a new Hobby class of license permitted to use the middle part of the band, the EIA proposal calls for moving all amateurs out of their proposed CB segment.

Considering the financial clout of the EIA, their Washington lobby, and the lack of any power in Washington by amateurs, we will be very lucky not to permanently lose substantial parts of this band.

-South followed by a supper and dance at the same location.

Sunday, May 2nd, a barbecue lunch, along with swap tables, auctioning, and raffling of door prizes will be held at the United Commercial Travelers Camp one mile east of Baton Rouge on Highway 190. The top door prize will be an SB-220 linear amplifier.

Each year that the event is held in Baton Rouge the attendance and activities grow larger and better. At last year's hamfest approximately 800 hams plus their families and friends attended.

ARMED FORCES DAY 1971 WA9DZL

On Saturday, May 15, 1971, WA9DZL, amateur station of the 128th Air Refueling Group (TAC), Wisconsin Air National Guard will again place radio equipment on the ham bands in conjunction with Armed Forces Day. A very attractive commemorative Armed Forces Day certificate will again be mailed to all hams who contact WA9DZL during this special 3rd annual operation. The operating schedule is as follows:

14.295 MHz, ± 5 KHz – 1300 hrs GMT thru 2100 hrs GMT
7.280 MHz, ± 5 KHz – 1300 hrs GMT thru 1730 hrs GMT
28.780 MHz, ± 5 KHz – 1730 hrs GMT thru 2100 hrs GMT
146.940 MHzFM – 1300 hrs GMT thru 2100 hrs GMT (Monitoring)

To qualify for a certificate a two-way contact with WA9DZL, an FHC member, and your QSL card are the only requirements. All QSL cards are to be sent to WA9DZL, 128th Air Refueling Group (TAC), General Mitchell ANG Base, Milwaukee, Wisconsin 53207.

The Extra class license was established in 1952 as a new class indicative of the highest level of achievement available, and a comparison of the present day and former examinations indicates the new license examination is more difficult. However, since the 20 word-per-minute requirement remains the same in comparison to the earlier requirement, the Commission has proposed that licensees receive credit for the 20 word-per-minute requirement if they have held an amateur Extra First Class license and have continued, without interruption, to hold the succeeding Advanced class license.

The eligibility period for the Extra class license would be reduced from two years to one year in order to sustain licensee interest by permitting repid upward movement in rank.

Navy Station Active for AFCEA

On-the-air ham radio facilities will be provided by the Navy's Washington voice in the amateur radio fraternity, K4NAA, operating daily from the Sheraton Park Hotel in Washington, D.C. during the three days of the Armed Forces Communication and Electronics Association Convention in June. AFCEA convention delegates with amateur radio licenses are invited to take advantage of the Navy's ham radio station to contact friends during the convention on June 8, 9, and 10.

The K4NAA fixed portable station will be operational from 0900 to 2200 EDST with two available positions for CW and SSB on the 10, 15, 20, 40, and 80 meter bands.

A specially designed QSL card has been prepared to acknowledge contacts with licensed amateurs throughout the world who are invited to make contact during the AFCEA convention.

The Navy and AFCEA invite all amateur radio enthusiasts to visit K4NAA on June 8, 9, and 10.

phone lines would not be able to handle the traffic necessary to coordinate an operation of this magnitude. Since the telephone numbers had been put out via the commercial broadcast sources, calls were coming in with offers of assistance and supplies so fast it was impossible to get a line for any kind of call out.

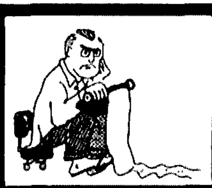
One of the volunteers who responded to the initial TV request for workers was also a ham who immediately saw the need for some sort of communication link to supplement the already jammed phone lines. Bob, WA6CZJ, is a member of the Grizzly Peak Radio Club which owns, operates and maintains a 2 meter FM repeater in the East Bay Area and provides excellent coverage to the Tiburon peninsula and the greater San Francisco Bay Area. Bob immediately set up a station at the Audubon headquarters and started operating through repeater WB6AAE on 2 meter FM. As operations expanded, Bob requested additional operators and equipment and within hours a complete emergency network was established with 9 base stations in operation at the strategic bird collection and treatment centers. Almost immediately the network became the backbone of the entire operation; not only did the hams provide an efficient system for traffic and message handling but a "conference net" was available when key officials wanted to confer on problems concerning the total operation. (This feature was to prove most important in later hours.)

As Operation Oily Boid progressed, more and more operators were required and more equipment was needed. Again the hams came through and a complete orderly communications link was manned by volunteers who came from over 100 miles away to lend equipment and time to help the birds. Word spread to other amateurs in the area and soon members of the VHF Expeditionary Society and the Pioneer Radio Club were working to Operation Oily Boid. In addition, the hams logged over 3000 miles patrolling beaches and shorelines during the five-day period the operation was conducted.

In retrospect, the entire operation was virtually interference-free through the repeaters, which were used simultaneously on two sets of frequencies. VHF FM provided clear channel operation where both CB and the HF bands would have been faced with interference and QRM emanating from outside the Bay Area. The use of the repeaters also allowed instant communications to be established through the use of hand-held mobile equipment working through the repeaters. "We would get a request for communications and immediately dispatch either a mobile or portable unit to the location to operate until a base station could be established and equipment delivered to the scene," said Tom Nelson (W6QGN), President of the Grizzly Peak Club. In fact, one operator worked mobile through K6GWE from Agate Beach for 12 hours, which provided the Audubon officials with an ear in an area which was virtually without any form of communications.

In all, *Oily Boid* was a success and thousands of birds were saved through the efforts of hundreds of volunteers who worked around the clock. But equally important were the efforts of the hams who helped by being there when they were needed to provide a service to the community.

The hams who participated actively will receive a special *Order of the Dirty Bird* certificate as a memento of the many long cold hours they spent operating "strictly for the birds."



NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

Assuming that my idea is all wet that amateurs can be encouraged to move up in license grade by the rewards of a distinctive call and that a highly structured and rigidly government controlled set of subbands is the answer, the recent FCC docket may be the ticket. Proponents of punitive licensing will, I suspect, be opposed to the very idea of offering rewards to those who get their higher licenses, preferring the system that punishes those who don't. Well, I've hit that gong enough for the last eight years and I'll let it be.

Your comments on the proposed changes in the phone bands should be in the hands of the FCC by June 1, with the usual 14 copies, if you can manage it. Perhaps, before you commit yourself to paper, some serious soul searching and objective (if possible) thinking will help you sort out not only what you personally feel about the new bands, but what you feel their impact on the future of the hobby may be.

While most of the new phone subbands are to be created from what were known as foreign phone bands previous to the development of sideband, a few of them will cut into CW bands or otherwise discommode present U.S. amateur use of the frequencies. I might point out that most of the foreign phone activity takes place within the U.S. phone band segments these days and that an expansion of our phone bands will have far less impact upon DX operators Street NW, Washington, D.C. 20554, know your considered opinion.

2m Airborne?

We just might be able to make it officially possible to operate on 2 meter FM from commercial planes. The catch is that we must have laboratory proof that our rigs are free from spurious emissions, particularly in the 108–118 MHz range. Perhaps there is a reader who is working with a recognized lab who could run such tests on presently available hand units by Motorola, GE, etc.?

Retirement for Wayne?

My amateur radio writing career started back in 1951 when I first published a bulletin for RTTY operators. This grew to over 200 circulation and ended when I became editor of CQ in January 1955. CQ and I parted in January 1960 and the first issue of 73 was in October 1960. Now, eleven years later, and after 20 years of editing and publishing for hams, I am beginning to think in terms of some sort of retirement . . . perhaps in two or three years or so.

It struck me that there might be an amateur out there somewhere with the business experience needed to run the magazine – who might be interested in 73. We have a fine staff and we are, in spite of the depression, operating in the black. 73 could, if run on a noncontroversial basis, make a very nice profit, probably picking up many more advertisers such as Collins,

German Repeaters

On the cover this month is the world-famous Fernsehturm, a needle-like tower jutting high in the sky over Stuttgart, Germany. At the top is a restaurant, a viewing room and a tower full of antennas. Most of the antennas, of course, are commercial types, radiating radio and TV signals throughout the countryside for miles around. But among the important commercial and industrial antennas are two insignificant quarter-wave omnidirectional radiators for 2 meters: the transmitting and receiving antennas for DLØSTA, one of Germany's first 2 meter repeaters.

The DLØSTA repeater inputs on 144.46 and outputs on 145.75 MHz. The radius of coverage of the Stuttgart machine is approximately 75 miles.

Other European repeaters currently in operation are these:

Call	Location	Input	Output
DLØJMA	Bayreuth	144.15	145.85
DLØCH	Cham	144.15	145.85
DLØUCA	Coburg	144.15	145.85
DJ9CRA	Cuxhafen	144.15	145.85
DKØRM	Frankfurt	144.15	145.85
DJ4JIA	Goslar	144.15	145.85
DLØBGA	Braunschweig	144 80	145.89
DJ3JWA	Lindau/Harz	144.15	145.85
DLØBLB	Ludwigsburg	144.85	145.30
DLØNFA	Nurnberg	144.15	145.85
DBØWZ	Wurzburg	144.15	145.85
DLØZU	Zugspitze	144.15	145.85
	Heidelberg	144.15	145.85
DLØZR	Schwerte	145.15	145.90

The frequencies noted in the above list are not permanent, according to a recent report from DL9GS. He says the consensus of opinion among German FM amateur radio operators is that the license authority will publish a new frequency allocation plan along with some rules governing repeater operation in Germany. The new requirement is expected to place all repeater inputs on 144.15 or 144.20,

the FM scene

by K6MVH

With the sudden burst of popularity of FM, all ham journals are carrying more material on the subject. Both CQ and Ham Radio have regular contributors they call "FM editors." Ham Radio's FM man is Jay O'Brien (W6GJO), an active and technically competent amateur who seems to be right up there in the forefront of the FM action. I have evaluated a number of O'Brien's technical manuscripts and have found them accurate, relatively up-to-date, and generally instructive.

But watch out for the CQ FM man, Glen Zook (K9STH). Zook's technical recommendations are often ill-advised and unsound. In the March issue of CQ, for example, Zook recommends use of Motorola "44" series 450 MHz equipment for repeaters – which is all right – but he suggests using the type with the "passive" front end rather than the superior "active" type.

The older Motorola 450 receivers used a pair of 6J4s in the front end which, in combination with Motorola's high-Q tuned circuits, offered excellent sensitivity and practically unmatched selectivity. With the advent of semiconductors, Motorola switched to a diode/cavity front end, which held up nicely as far as sensitivity was concerned but fell flat in the selectivity area. As a consequence, Motorola retained the "active" 6J4 front end for its repeaters, and used the "passive" units for ordinary bases and mobiles. Motorola made the right decision; the diodes just couldn't compete, selectivity-wise, with the 6J4s. If you have a choice, ignore Zook and grab the active-front-end receiver for your repeater.

town could produce so many amateurs in one place at one time. An even bigger surprise was the number of active FM operators; it looks like some 70% of the hams in the Midland area are also 2m FM operators. Needless to say, the FM portion of the meeting racked up the biggest attendance records.

There was a slight sour note. During my talk, I wanted everything to be informal, so I invited members of the audience to break in at any time with questions or comments. Roy Allbright, the local ARRL director, did. He seized the opportunity to lash out at 73 for profiteering, and pointed out that the League is a nonprofit organization dedicated to serving the needs of amateur radio in general. He didn't believe me when I told him that QST turns a better profit than all the other ham journals combined. He also made a few caustic remarks about Wayne Green.

Now, I expect League advocates to badmouth 73; after all, we at 73 continue to be a thorn in the side of the ARRL as long as we don't concur 100% with what they do up there in Newington. But I've had it up to here with people who make snide comments about Wayne. In most cases the fellows who make their little vitriolic statements have never met Wayne. They don't know him except from what they read in his editorials.

The fact is, Wayne Green is the most dedicated amateur I've ever met. He puts ham radio before business. To the detriment of 73, he will speak out on issues that are predestined to make him unpopular – all for the sake of amateur radio. Wayne has the kind of

today than it would have in the old AM phone days.

Think it over carefully. Talk it over. Argue about it. You might even try arguing both sides, if you can handle that type of thing. When you're done sit down and let the FCC, 1919 M Eimac, Millen, etc., and a lot more subscribers. It should not be difficult to increase our present small profit by well over $100,000 a year, if this sort of thing is of any great importance.

Anyone with the background and wherewithal out there?

and all outputs on 145.75 or 145.80 MHz.

In Switzerland, only 450 MHz repeaters are allowed. And there have been no repeaters reported for Holland, Belgium, or Luxembourg. However, according to information supplied by DL9GS, there are a few Austrian repeaters using the 144.15/145.85 MHz pair.

Zook also shows control circuits operated from 115V ac. *Don't you be foolish enough to use 115V for your control functions* – it's just not worth it! Primary 115V power on open relays is dangerous, for one thing. For another, high-voltage ac relays are expensive – often unobtainable on the surplus market. But, most important, a flock of relays and wires with a 115V, 60 Hz signal on them, is an introduction to problems of "hum and buzz" another nemesis to the well-designed repeater. The first-class way to go for control switching is 24–28V, and all dc.

Please forgive me for being negative. FM rates the biggest push we can give it, and the more said in the amateur journals, the better. Read the FM columns by all means. But keep a wary eye peeled. I know whereof I speak.

On Hamfests and Such. . .

I just returned from a very successful hamfest in Midland, Texas. The big surprise was that this relatively small

integrity that makes him speak his mind regardless of the consequences, which are often unfavorable businesswise.

When Wayne should be working, he is frequently in the hamshack making DX contacts. When he should be devoting time to his family, he'll often devote it to hamming on his 2m FM walkie-talkie. Then, late at night, when everyone else has gone to bed, he'll get stricken with a belated attack of conscience and slip into his office to make up the work he's missed during the day.

And that's not all. Wayne is a good human being. Equally affable with heads of state or factory workers, he is a friend to anyone who offers friendship. And, what is most important of all to me, he is MY friend – which makes me deeply resentful of uninformed upstarts who get up before audiences and make statements that are untruthful, unfounded, and just plain stupid.

Dayton Hamvention, April 24

Don't dare miss the Dayton Hamvention this year; it looks better than ever. The program will be leaning heavily toward the FM field, in recognition of the intense interest being devoted in this area during recent months. GE's Paul Perrone (K4CYJ) will be demonstrating his company's unique receiver voting system, which should give aspiring repeater owners some food for thought.

The Miami Valley FM Association will operate talk-in services on a continuous basis on Friday and Saturday (April 23 and 24). The talk-in frequency will be 146.94 MHz, simplex. Repeaters in the area that can be keyed from mobiles in the vicinity of the Hamvention will be operating on the following pairs: 146.34/146.76, 146.46/146.88, 146.22/146.82. A 6 meter simplex station will also be manned on 52.525 MHz.

The Hamvention boys have set up a hospitality room at the Imperial House North Motel – this affair gets under way Friday night at 9.

LETTERS

ou goons don't ever proofr

I insist that you print ev

I am reading with great interest and enjoying 73 tremendously. I always look forward to the new issue.

Hussein
THE ROYAL PALACE,
Amman, Jordan

Not much organized activity yet. But check the page of national FM standards, April issue, for 220 MHz frequencies. Articles are in the works.

. . .Ken

Layout – Pro

I haven't commented on it before but your new layout is the best in the business in my opinion. Also appreciate your variety. I wonder how that other mag from New England can make it in this business as narrow and pseudo-sophisticated as it is.

Joseph T. Taylor K5PAC

FM

For some time I have been contemplating the idea of getting on 220 MHz. Since FM is the only way to go, I was wondering if there is any activity of this nature at this time. I would like information as to national calling frequencies and established repeater frequencies. Also, I would like to see information in 73 on conversion or construction of equipment for this purpose.

George E. Jones WB4AQR
5803 12th Street
Tampa FL 33604

I wish to thank you for the VHF FM articles in your magazine. They are enjoyed by all the hams here at WWNC radio. Can you tell me the FM repeater frequencies in use in the six-state area surrounding western North Carolina? This information would be useful to me because of our altitude and interference problems. In the very near future we will have a repeater going and will let you know the frequency decided on.

Glen A. Bell,III
WWNC
Asheville NC 28802

Check repeater directory, April issue, as well as article on intermod problems. Should help.

. . .Ken

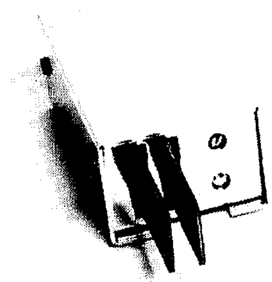
Goodwill Hams

I was pleased to read W7SCU's letter in the January issue about his purchases at the local Goodwill Industries store. There are over 143 local and autonomous Goodwill Industries' throughout the United States. Each unit has on an average of five retail outlets in which very interesting and unusual merchandise is available.

The sale of this merchandise thru our retail outlets helps to make payrolls for handicapped people. Our philosophy in the Goodwill Industries Movement is "A Change, Not Charity."

(continued on News Page Four)

NEW PRODUCT



A new deluxe key from James Research, packaged in a polished chrome plated steel cabinet, measures only 1 9/16" high by 2 1/4" wide by 3 3/4" deep and weighs 14 ounces total. The completely enclosed permaflex mechanism has independent fiberglass paddles which flex to make contact and have adjustable gap and tension. Additional feet allow the key to be used on its side as a straight hand key. The 8-ampere gold diffused contacts will key a transmitter directly or the low level inputs of an IC keyer. Included with the key is an internal bracket and blank printed circuit board to permit home brewing a keyer or other circuit. Pre-punched 1/4" diameter front panel holes will accommodate standard and imported subminiature switches and potentiometers.

The key is 100% US-made by James Research and is guaranteed for one year. The key is available by direct mail only for $24.95 postpaid. This includes parcel post shipping and insurance in the United States. For further information contact James Research Company, Department AR-D, 20 Willits Road, Glen Cove, NY 11542.

(continued from News Page Three)

At Goodwill Industries of Central Pennsylvania in Harrisburg, we have started Novice classes for handicapped people.

73 is a fine magazine!!

Lowell W. Carter WA3NXR
Executive Vice President
Goodwill Industries of Central Pennsylvania, Inc.
P. O. Box 3327
Harrisburg PA 17105

Fine Print

I note with interest (in March letters) W6VVF's comments concerning his reading the fine print in your excellent magazine. As an optometrist, I can sympathize, both with tongue in cheek and seriously. I am 45 and very much require my bifocals for all close work. Even I pulled out the bar magnifier to read page 24 listing the FCC petitions.

I am sure you have many partial-sighted readers. I am equally sure they have great difficulty reading segments of your magazine.

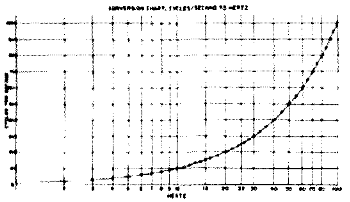
In answer to W6VVF, I promise you, Mr. Nichols, we optometrists have no conspiracy going. Prevention of visual problems is very much our concern.

J. H. Robinson, O.D. (WØRJZ)
218 W. Montgomery
Creston IA 50801

Keep up the good work. I still enjoy the magazine very much. I have only one *small* criticism. Please do not print the first few pages on their sides. It makes it awfully hard to read. The small print is bad enough, at least print the pages right side up.

Robert Z. Muggli WN9CVX
17938 Homewood Ave.
Homewood IL 60430

As a subscriber from the very beginning I'd like to put in a vote against a repitition of that monstrosity you put in for an index in the Dec. 1970 issue. It is as near unreadable as you can get, or I thought so until I saw some of the minia-



up to the minute in state-of-the-art understanding of electronics.

Douglas H. Horner
1260 E Ave.
Marion IA 52302

I would appreciate it if you could explain the "management" of them, specifically answer the following general questions. I'm sure others have been wondering about the same thing.

Who owns a typical repeater?

Who paid for its construction?

Who performs required maintenance?

Who pays the electric bill?

Who is responsible in case they cause injury or other damage (e.g. start a fire)?

Can anyone (with proper equipment) use one?

If I were to use one would I need permission from the owner? Would I have to contribute to its upkeep?

What motivation is behind their establishment? (Especially if they are not a "money making" venture)

Are there any special restrictions on the "operators" who use them?

Who owns the property they are located on?

How are they protected from unauthorized tampering or vandalism?

Perhaps you could answer some of these questions in an editorial or "Leaky Lines" column of 73 if you feel this subject needs further discussion.

John J. Risch WØFEV
7135 Farley Ave.
St. Louis MO 63121

Let's take your questions one at a time.

1. Who owns a typical repeater?

Say a few of the fellows who operate on one of the local FM frequencies decide it would be a good idea to get increased range and more reliable coverage. So they get together and make a decision to put up a repeater. They form a club and get as many people into it as they think their repeater will accommodate without crowding. Each club member is expected to pay dues and contribute materially to the repeater's development. Then, as a group, they apply for a repeater license and begin construction on a joint basis.

the job of a kilowatt.

9. Are there special restrictions for repeater users?

Sometimes; it depends on the club and its members.

10. Who owns the property?

Clever hams find property in various ways. Some rent from the state or federal government, while others contact land-owners who have choice high locations.

11. How are they protected from vandalism or tampering?

All kinds of clever ways. Some people install repeaters in locked buildings, and others install them on vulnerable power poles. Still others are stashed in garages, shacks, or bedrooms. But protecting the repeaters becomes a fun-type challenge that should appeal to all true experimenters. Intercom arrangements, for example, can be incorporated into a system so that if an intruder is in the vicinity, the repeater comes on and all sound in the area of the repeater is relayed to the control point on the UHF or wireline control link. The repeater owner can then note whether or not the intrusion is a bonafide burglary, and notify the local authorities if necessary. He would also have the capability of shutting the system down if the alarm turned out to be spurious.

All of these questions and others are answered in depth in "Radio Amateur's FM Repeater Handbook," Editors and Engineers, Ltd., Indianapolis IN 46268 ($6.95). And if you are interested in repeaters from a lay point of view, why not send for a copy of "An Introduction to Amateur FM," available from 73 Magazine ($1.50).

. . . Ken

Phone Patches

A couple of comments on W4NVK's article in the February 73, *Phone Patch Level Adjustments and Manproofing*: His otherwise fine article makes one bad statement, and that is that he recommends the use of

Plaudits

Thanks very much for your fine magazine, and your late better format, with editorials, ham news, etc. clear across the page, and not continued in back of magazine – much easier to read. Keep up the fine work, and all the best.

Chester M. Benson W9IFB
732 So. 14th St.
Richmond IN 47374

I owe you an apology for not writing long ago and telling you how pleased I have been with the results of my modest advertising in 73 Magazine. Other than QST, my only written advertising has been in 73 since 1966 when I first introduced my new TRANSKEY electronic keyer. I can say that your magazine is nearly totally responsible for establishing my entire sales program for the keyer . . . and this includes sales in foreign countries where buyers have seen your ads.

I agree with your philosophy concerning the best of hobbies, ham radio, and will continue to do all I can to interest young people in ham radio. I will also continue to boost our hobby before my friends in Washington, D.C.

Howard Furst W6PHA
P.O. Box 246
El Toro CA 96230

Snowfall

All of us at Mount Snow appreciate the excellent article, *To the Repeater*

Bet he'll not forget again that Circuit-Stik is available from Circuit Specialists, Box 3047, Scottsdale AZ 85052.

Ouch!

Somebody should put a *bleeder* of some sort across the power supply, page 41 (March 1971). 16 ηF of "oils" will hold a 1.3 kV charge too long . . .

Neil Johnson W2OLV
74 Pine Tree
Tappan NY

Right on!

Real Dedication

I was both surprised and delighted to receive your check as payment for the materials that I forwarded to you concerning the late R. V. L. Hartley (May 1971). Your policy of paying well and promptly for all materials that appear in 73 Magazine is aptly confirmed.

However, I am unable to accept payment for the material. It was submitted for publication out of respect and friendship for Ralph Hartley, who, as you know, was an Honorary Member of the New Providence Amateur Radio Club. Nor could the Club accept payment for the material. Publication in 73 as our tribute to Mr. Hartley is more than enough reward for us.

I suggest therefore that you use the money to purchase a good article on some subject of interest to all amateurs for publication in 73. Dissemination of useful information in this fashion would be in keeping with Ralph Hartley's admiration for amateurs. Although not licensed himself, he truly appreciated that way in which amateurs consistently demonstrated the applicability of many of his ideas long prior to their commercial acceptance. I'm sure he would have approved.

Alfred E. Hirsch, Jr. K2SKV
33 Evergreen Rd.
Summit NJ 07901

turized printing in the last issue. What gives?

John C. Carroll WA6YTR
155 E. County Line Rd.
Calimesa CA 92320

Why the sidewise print on so many pages? Why the small print? How many can read the Wayne Green petition on page 124 in the March issue? If it's worth printing then it should be printed in large enough type so that it doesn't take a magnifying glass to read!

Jos. P. Fincutter K3STU
5620 Alta Vista Rd.
Bethesda MD 20034

I used to enjoy your news pages but in Feb. I needed a magnifying glass to read it. There is no excuse for using print smaller than the telephone book. It was just too much effort to finish reading it.

Marv W4SPQ
6209 Thornwood Dr.
Alexandria VA 22310

Wild One

Can you give me a lead on some VHF FM equipment? I'll go insane trying to figure this thing out without a schematic! It's 3 pieces of Westinghouse equipment: power supply, transmitter, & receiver. Each is approximately 8 in. wide, 6 in. high & 18 in. deep.

Power Supply (Style 1473613A)
Transmitter (Style 14770034D) [2-6146's]
Receiver (Style 1477038K)

Can anyone steer me toward the address of Westinghouse or anyone else who might be able to sell, rent, or loan me a schematic?

Bruce Tiemann WB2RUH
304 Laurel Ave.
Woodlynne NJ 08107

Any takers?

Repeaters

I have read many articles regarding repeaters. However I failed to find one which explained the logistics or economics of them. Perhaps I did not read the right articles.

2. Who pays?

The dues should pay for just about everything the repeater will involve: and if the dues do not cover an expenditure, the club's board of directors will most likely assess club members for an additional amount, depending upon whether or not such an expenditure is upheld by popular vote within the club.

3. Who performs the required maintenance?

Most repeaters have one or two individuals who like the technical end more than the communicating end. These are the folk who get the maintenance jobs. Usually, as compensation for their efforts, they are entitled to an honorary membership and thus are not required to pay dues or assessments.

4. Electric bills?

The club pays.

5. Who is responsible in case of fire or injury?

Hopefully, the insurance company who was unlucky enough to think it was a shrewd move to sell insurance to the repeater group in the first place.

6. Can anyone with proper equipment use the repeater?

In general, yes -- but with a few qualifications. In most cases, repeater groups will welcome all "transient" operators (operators who do not live in the area but who pass through occasionally and wish to use the machine). But if you live within the coverage area of a repeater and plan to use it to any substantial degree, your best bet is to join the repeater club. Only one or two cases have arisen where new members are discouraged; and these have blackened the eye of FM to such an extent that most groups lean over backward now to be courteous and friendly to newcomers.

7. Does one need permission?

Only when regular usage is contemplated.

8. What motivation is behind the establishment of a repeater?

The desire to have reliable communications over a given area, and the appeal of using walkie-talkies to do

polarized electrolytic capacitors in his manproofing scheme. If electrolytics are used here, they should be of the *nonpolarized* type, for two important reasons.

First, the dc polarity on many telephone lines frequently reverses. This polarity reversal is used in many instances for signalling purposes (called, curiously enough, reverse-battery signalling). It happens very frequently when toll calls, 211 (long distance) or O (Operator) are dialed. Since a great many phone patches are handled through an operator, a good possibility exists that the patch may indeed be run with a line polarity opposite to that of the coupling capacitors. This type of reverse-battery signalling is not universal, but its use is widespread enough to warrant a test for it before one uses polarized electrolytics (the line polarity will reverse after the last digit of a toll call or operator call is dialed).

The second reason for not using polarized electrolytics is that the ringing voltage is ac (20 Hz) and, should the patch be inadvertently left on and the phone rings, the ringing voltage could destroy the capacitors, causing the very thing you are trying to prevent. Further, the ringing voltage is approximately 110V rms, giving a peak-to-peak voltage of almost 300V. The voltage rating of the two capacitors must be at least 150V in order to safely withstand the peak voltages present during the ring cycle.

Ray Pichulo W1IRH
172 Dent St.
West Roxbury MA 02132

Nonpolarized electrolytics can be formed by series-connecting two polarized eletrolytics back to back. Connect the positive leads together.

. . .Ken

Better Understanding

The enclosed chart came across my desk the other day and it was immediately apparent that this is exactly what your readers need to bring them

on Skis, in your issue of March 1971. In fact, we could make good use of some extra copies and would appreciate receiving some for our publicity purposes.

Once again, many thanks to the author, Gordon Pugh, and 73's staff for the excellent article.

John M. Christie
Vice President
Mt. Snow Development Corp.
Mt. Snow VT 05356

Circuit-Stik

You guys are really eating the green one. Why did you bother to turn everyone one with a description of Circuit-Stik without telling us how to get hold of the guys who purvey it? Let's get out of the "sled" position and straighten out this mess. Where can I get samples of the stuff? Who do I write to to get more information?

Richard Shyer
Mansion of the Slaves
2455 Barjud
Pomona CA 91766

I saw the article by Ken Sessions Jr. K6MVH about the PC Construction with the Circuit-Stik in a kit. Needless to say I was instantly interested. What is the address of this Circuit-Stik company, so I can send off for some more information?

Jim Vinnell W6DEU
851 California St.
San Francisco CA 94108

Your article on Page 61 March issue about Circuit-Stik was very interesting and we would like to try some. However, I've searched diligently and can't find out where to get it.

Please give me the supplier's name and QTH so I can get some.

Wm. H. Coleman K4DMD
Cornell-Dubilier Electronics
2652 Dalrymple St.
Sanford NC 27330

We recieved several hundred letters like this, all of which have been answered individually by the author, who was responsible for the oversight.

Expansion

I wish to express my wholehearted approval of the recent FCC proposal to expand the 'phone bands and to allocate more frequencies to the Extra class licensee.

I would also like to express my desire to see a reduction in the power limit for amateur transmitters. This would have to be in the form of a rule requiring a limitation on the total amplifier plate dissipation. The rules concerning dc power input are totally disregarded by many amateurs who run up to 10 kilowatts or more input to multiple 4-1000-As.

There is no adequate means of policing the present rule, especially when SSB is used. If an amateur's transmitter were limited to a total plate dissipation capability of 500–1000 watts with a mandatory license suspension for anyone with a larger transmitter in their possession, whether in use or not, it would be a great deal easier to enforce the rules.

Melvon G. Hart WØIBZ
936 Dontaos Dr.
St. Louis MO 63131

A Nice Letter

Yours is a fantastic magazine,– only wish I'd heard about it earlier. You have your competitor magazines beat 60 times over. Here are a few reasons why–

1. The General Class Study Course This is really just what I was looking for. As a Novice, which implies little more than an idiot in the ways of radio theory, I needed a step-by-step study course in some questions. Dry textbooks just don't compare. My dad, who is trying to learn the theory, and I both use the course and understand perfectly. When I am at the proper level, I will probably buy the Advanced Class Study Guide in your radio bookshop, and increase my theory with that, also.

2. Your Editorials.

I commend you for saying what needs to be said. The ARRL is an organization that is sorely needed by all hams

in the U.S. but, as I am now aware, it is not the typical knight in shining armor. Keep up the good work. Inform us of the faults in the world of hamdom, and maybe 73 will soon be standard reading in ARRL headquarters.

3. Easy, workable, practical projects.

I may never need a $300 Morse-a-verter, nor a $500 homemade transceiver for 160 through 6, but these articles are great to look at and wish for. However, as soon as I finish the automatic keyer in the November 70 issue, I'll probably start the IC marker generator in the October issue. Your projects are all practical and needed items around the shack, and I intend to build a lot of them.

4. Your ads.

Believe it or not, my dad and I find your ads for 73 products simply supreme. What I am referring to, of course, is your subscription ads, your Gunsmoke ads, and of course: "Tell our advertisers you saw it in 73, even if you didn't." It's nice to know that hams have a sense of humor, also.

Unfortunately, I must cite the dark lining of your silver cloud. I agree with R. G. Kueha (letters, December). Your titles ARE quite large, and at least 1 or 2 other articles could be placed in each magazine if the space you now use as titles were halved. This is one change I would approve.

Anyhow, 73 is a fantastic magazine, and it is one worth getting. Thank you, and 73.

David Bekin WN6PYG
19856 Schoolcraft St.
Canoga Park CA 91306

Propagation

At one time the Propagation Chart by Mr. J. H. Nelson contained information on VHF openings. For the past many months this has been missing. How come?

Being a VHF operator I found this very helpful in looking for good band openings. Please if possible include FM Repeater Handbook & find it a very useful & informative publication.

Jack A. Rash

Reader service has been a fiasco, but things will improve with a new child-operated system we've initiated. . . .Ken

The League

Oh boy! Did you persuade Wells Chapin, W8GI, or did he volunteer? His comments on ARRL, in your January 1971 issue are manna from some sort of heaven.

I too, am a member of ARRL with many years of support to my credit. Matter of fact, I am happy to reflect upon my status as a life member. But however you cut it, I am not happy with the image that ARRL is creating. Amateur radio is to some a hobby, and to some it is a vocation, so it cannot be administered to as a craft union. And it seems to me that, more and more, the approach of Newington lies in that area.

A thoughtful reading of Chapin's article will not only clarify cause and effect, but it will suggest ways and means whereby dead weight can be transformed into something approaching energy and purpose.

Alden W. Smith
Penury Priory
Temple NH 03084

The ARRL reminds me of a foghorn; at least with you guys I can tell that there's some*body* out there, and you're *different*!

You'd better keep Fred Mocking or I'm a goner – I made it through General on sheer momentum.

Pete Lamasney WB6AZF
654 Cunard Dr.
Napa CA 94558

There seem to be so many things that can be done by the League but with only one board meeting a year, the operation is basically run by the staff.

After two campaigns now for vice-director I have come to the conclusion in my own thinking that those who are vocal or want to see something done are no longer members and those who are left are just too apathetic and don't really care.

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Bill Peterson K9OWQ
P.O. Box 482
Midlothian IL 60445

The info is always there. Look on the last page of 73.

. . .Ken

Repeater Rules

I would like to know the latest on the FCC rules concerning repeaters. I have been out of touch for the last couple of months since my copies of 73 are going home while I am here for TDY. Thank you very much for everything.

Patrick Brown WA9FCG/5
CMR No. 4, Box 20016
Keesler AFB MS 39534

The FCC is just now beginning to consider the drafting of new repeater rules.

. . .Ken

A Real Mover

By all means renew my subscription to 73 for 3 years, as I couldn't *bear* to miss any of the fine educational articles mixed with a dash of humor to make life a little more *bearable*.

I started with you in 1960 in "6" land, to "7" land, to Ø land, and finally to 9 land. Hope you will not, ever, change your attitude toward bureaucratic boondoggling.

Larry Brooke W9LSS

Please do not speak ill of ARRL like that.

I Give Up

Well, you finally did it. After three months of sending in your Reader Service coupon, and not getting even one reply, I decided it was because I was sending in too many requests, or because I hadn't subscribed to your magazine, yet. So, enclosed you will find a money order for $6 for a one-year subscription, as well as the Reader Service coupon from the February issue. (The March issue hasn't hit my local newsstand yet, but I hope to get it soon.) All joking aside, I enjoy 73 very much and should have subscribed to it a long time ago.

I have recently purchased Ken's

After hitting my head against the brick wall so many times I'm about to join the apathetic group and breeze along in other endeavors.

Gary A. Stilwell
7164 Rock Ridge Terr.
Canoga Park CA 91304

I do not wish to renew. I am tired of your lambasting the ARRL, "Leaky Lines" Dave Mann March 71. All Dave is interested in is a new country and not promoting goodwill among nations.

Vance E. Gildersleeve W5GST

Flix

Any groups like to see a film of the Westchester Amateur Radio Association's Field Day activities? We have about a 10-minute black and white documentary film on Super 8. Although the sound is presently on a separate tape, it can be put directly on the film.

I appreciate your study courses, and am waiting for the General series to be complete so that I may stand a chance in getting rid of my Novice call.

Elinor H. Stecker WN2MYK
(Mrs. Arthur Stecker)
16 Kilmer Rd.
Larchmont NY 10538

Poor Peoples' Radio

I thought you might let your readers know about Poor Peoples' Radio, Inc. We were granted a construction permit on November 19, 1970 from the FCC for an educational FM broadcast station to serve San Francisco. The proposed station has been granted callsign KFPR and we will operate on 89.5 FM with 10 watts output. We have permission from KGO-TV to place our antenna on their tower on Mt. Sutro, and this is the highest point in San Francisco, being about 830 ft. above sea level.

We are looking for help in the form of volunteers, money, parts, etc. If any of your readers would like to call me, the home landline is (415) 751-1974.

Meyer Gottesman W6GIV
863-25th Ave.
San Francisco CA 94121

Why is it that all the FM operation is being crowded into the 146–147 MHz segment of the 2m band. When is somebody there going to wake up and see the potential harm to amateur radio that is building up by allowing this situation to become further and further entrenched into our operating practices. As time goes on, the section 147–148 MHz is becoming more and more vulnerable to commercial take over. Its position in the spectrum makes it a natural objective for commercial radio users. Keeping amateur FM below 147 MHz is not helping matters any.

Joe Cusimano VE3OV
2480 Bayview Ave.
Willowdale, Ontario
Canada

You're running scared a little too soon. Remember, a few years ago there was no FM operation at all, and the AM people were spread over the entire 2 meter spectrum. Today, FM exists between 146 and 147 MHz (though many areas are active above that), and the AM'ers are settling above and below that 1 MHz spread. FM'ers are not made up of oldtime 2 meter AM men – they represent hams who have come from all areas of our spectra. Thus, the FM activity isn't causing a squeeze on 2 meters – rather it is causing an expansion of activity there.

. . .Ken

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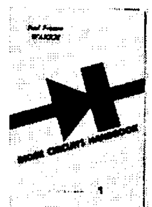

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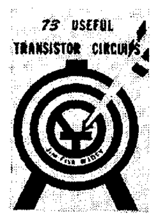

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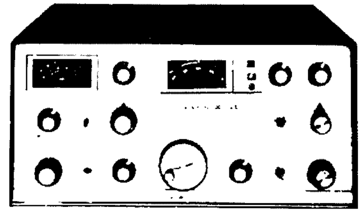

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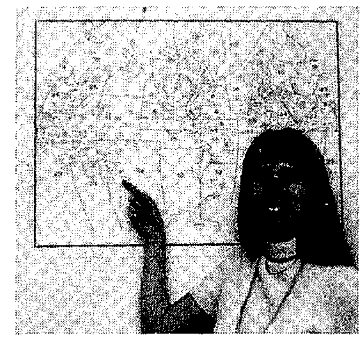

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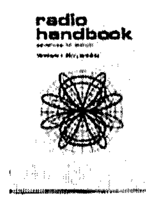

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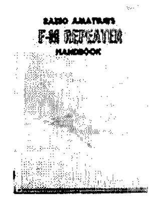

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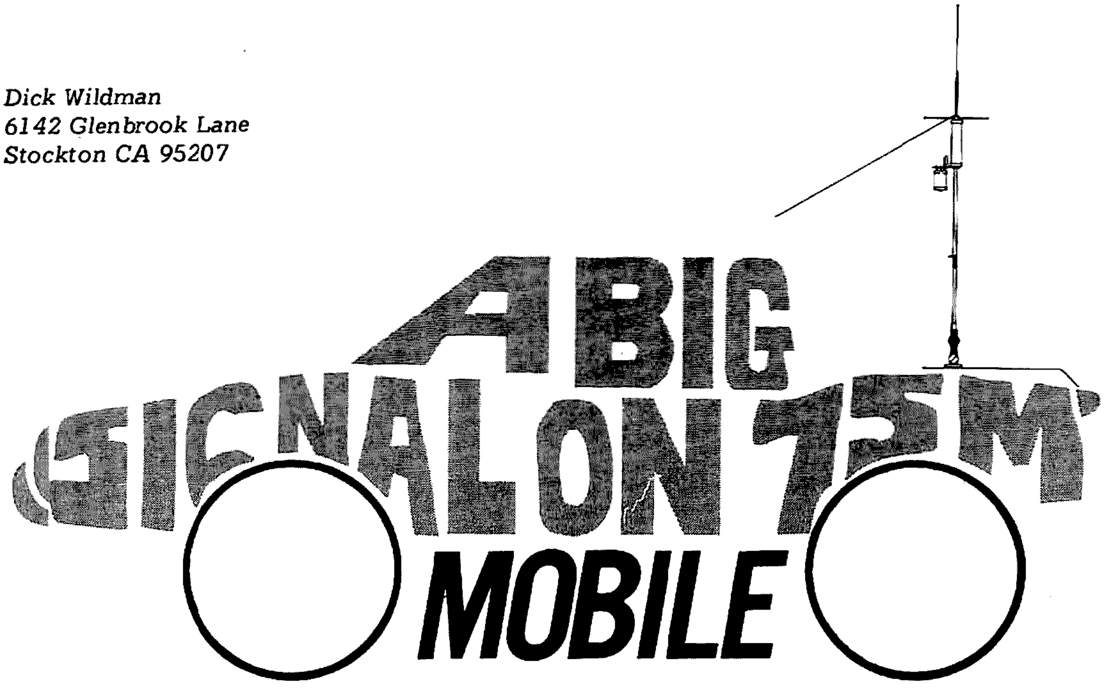

The 75m mobile antenna I use raises a few eyebrows now and then, but it really works, and does so exceptionally well. It is the best performing 75m mobile antenna I have ever had the pleasure of owning. It is of the homebrew variety, using all commercially available components. There is nothing really new in its concept except that I have adapted the features of many different antennas to come up with one that maintains high Q and high performance over the entire phone band. It does look a little different and somewhat weird to those who do not know what it does and what it is for. The antenna consists of an adjustable top-section whip antenna, a three-spoke capacity hat, a long and large center-mounted loading coil, a rotary inductor (center mounted just below the main loading coil), a long tilt-over base section mast, and an inside-the-trunk base matching network (switchable).

The success or failure of mobile operation depends entirely upon the efficiency of the antenna installation. In mobile operation, one must compete with extraordinary noise levels, QSB, and high-power fixed stations. This immediately puts you at a distinct disadvantage. Considering all of these factors, the highest efficiency mobile antenna you can put on your automobile is obviously a must if you want good, solid communications. The physical configuration of my antenna was chosen with regard to the highest possible performance rather than how it looks.

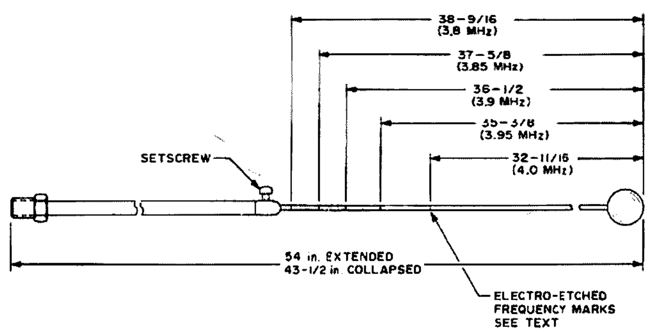

Fig. 1. Top section whip.

The Whip

The top section whip is adjustable in length. It is a two-section telescoping unit with a setscrew on the side for locking the length after adjustment has been made. The base of the whip is threaded and will mate with the top of the loading coil. The top of the whip has a large corona ball on it about ½ in. in diameter. The whip is made by Webster (No. MA-7). The extended length is 54 in. and the collapsed length is 43½ in. This gives me 12½ in. of adjustment. See Fig. 1.

Capacity Hat

The capacity hat (Fig. 2) is of the homebrew variety. It consists of three

equally spaced (120 degrees apart) threaded brass rods 8¼ in. long. The use of this capacity hat above the loading coil effectively lengthens (electrically) the top section whip. The hat increases the effective capacity of the top section whip to ground. This also allows for the shorting out or removal of some turns on the main loading coil which is always desirable. The overall effect of the capacity hat is to bring the rf up into the upper portions of the antenna and away from the car body which has detrimental effects on performance such as absorption and detuning of the antenna.

The Loading Coil

The all important loading coil is the heart of the loaded low-frequency whip antenna. Its purpose is to cancel the negative reactance offered by the short antenna to the tuning device. The shorter the whip antenna (compared to a quarter-wave antenna), the greater the negative reactance offered to the tuning device. The loading coil adds an equal and opposite amount of positive reactance to the antenna circuit. This will neutralize the negative reactance of the short whip, leaving only the radiation resistance of the whip and the inherent losses of the loading coil as the terminating load for the tuning device.

Unfortunately, most loading coils are far from perfect. They exhibit resistance as well as reactance. The ratio of reactance to

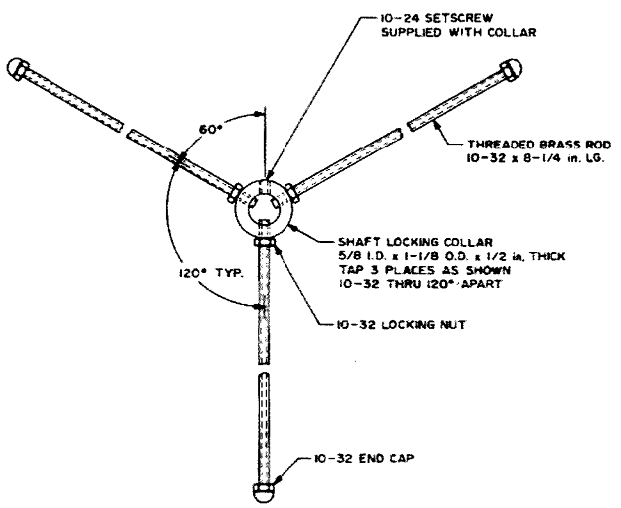

Fig. 2. Capacity hat detail.

the rf resistance is given by the symbol Q. A coil having a reactance of 1200Ω and a resistance of 10Ω is said to have a Q of 120. If this coil is used with an antenna having a radiation resistance of 8Ω, the coupling efficiency is then 8(8+10) x 100, or 45%. Over half the output power of the transmitter is lost in the loading coil. If the radiation resistance of the antenna is only 4Ω (as it may well be with base loading), the coupling efficiency is then 4(4+10) x 100, or 28%. This means that 72% of the transmitter output power is lost in the loading coil. This power can only be dissipated in the form of heat generated in the loading coil itself. For this reason, I chose center loading. Improving the efficiency of the loaded whip antenna means increasing the radiation resistance of the antenna by using either a center- or top-loaded whip antenna. The center-loaded version is the most practical method to use from the standpoint of available commercial parts. I found out by experimentation that the longer, thinner coils, rather than the shorter, fatter ones, consistently gave me higher field-strength readings. This would indicate that the coil is actually radiating energy in conjunction with the whip antenna. With this type of coil, overall antenna efficiency should be on the order of 60 to 70%. The coil I chose was a Master-Mobile Ultra-Hi "Q" 75/80 meter loading coil (Fig. 3). It has well spaced coil turns (about 1/8 in.) to eliminate arcing at high power. The coil is 13½ in. long x 3 in. in diameter. The coil has 95 turns on it. It is housed in a clear plastic cover with yellow end caps.

The Rotary Inductor

The rotary inductor is a Master-Mobile Micro-Z unit. The basic rotary coil measures 1 x 3 in. long. The housing measures 3 x 4 in. It is designed for manual rotation and has a turns counter (numerals marked on one end cap). The tap to the coil is accomplished by a grooved wheel, mounted so as to slide on a bar. The grooved wheel rides on the coil. There is a coupling capacitor mounted between one terminal and one end of the rotary coil (Fig. 4). I removed this capacitor and discarded it and

made the input and output contacts continuous through the coil via the roller contactor. I fabricated a mounting plate for the rotary inductor which I mounted on the bottom side of the main loading coil. The rotary is mounted to one side of the main center line of the total antenna.

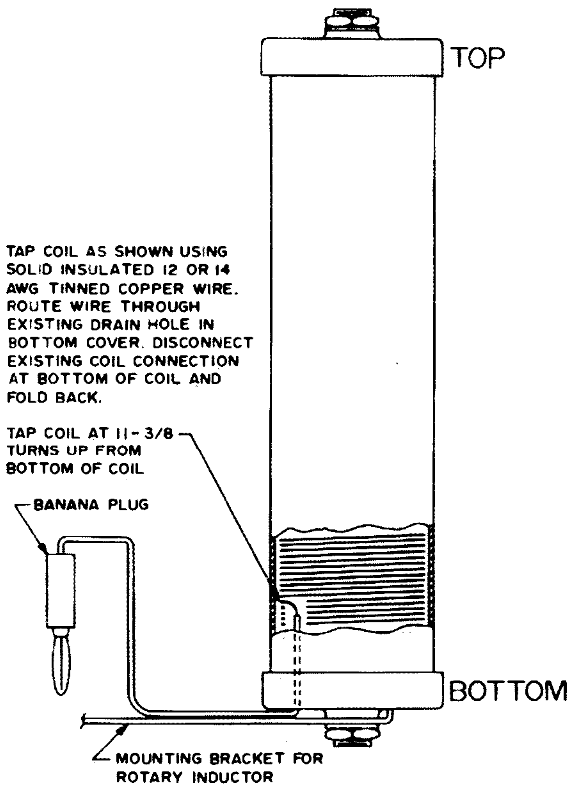

Fig. 3. Loading coil detail.

Operation of Loaded Antennas

One of the penalties that must be paid for high Q and high efficiency in the antenna system is that the tuning of the antenna becomes extremely sharp. It is necessary to adjust the loading accurately, and to adjust it for each significant change in operating frequency. To put this in practical terms, if the frequency is shifted 5 kHz without reloading, no appreciable loss will result; 10 kHz and the output and the plate current of the transmitter will start to drop; 15 or 20 kHz and the performance will seriously suffer. Obviously, some means must be provided for adjusting the antenna loading or some other portion of the circuit to tune out the antenna reactance at each frequency setting.

On 40 meters, the problem is somewhat less pronounced. First of all, the loading coil is smaller, and the whip is longer in proportion to the wavelength than on 75 meters. Changes in frequency of 30 kHz of the operating frequency may be made with no appreciable loss of antenna circuit efficiency. However, for changes of 50–100 kHz, again some means of varying the antenna loading must be incorporated in the antenna system.

Maintaining Antenna Resonance

On 10, 15 and 20 meters, the whip antenna (usually one electrical quarter-wavelength long) will usually tune the entire phone band or the entire CW band with little difficulty. On 40 meters, the loaded whip antenna will usually tune about half the phone band, and going beyond that requires some means of varying the inductance of the loading coil. On 75 meters, unless one is entirely satisfied with being restricted to one very narrow operating frequency, some means of varying the inductance of the loading coil is an absolute must. The resonant frequency may be varied by either of two basic means: by altering the length of the whip antenna above the loading coil, or by varying the inductance of the loading coil itself. I employ both methods. To vary the length of the top whip section by any other means than doing it manually is very difficult. To vary the inductance of the loading coil, one can do it manually or by remote control. Tuning this coil can be done by running an insulated metal strip from the top side of the loading coil down past the side of the coil and adjusting the length of this strip by rolling it up and down with an old-fashioned can opener key, or a sliding tap on the coil will do the trick. Or try running a brass slug up and down inside the coil with the slug electrically and physically connected to the bottom side of the coil. You can also use relays to switch in taps on the coil, or use a rotary inductor in series with the main loading coil.

In brewing up my 75 meter mobile antenna, I chose to incorporate the best of all of the different methods of obtaining high efficiency and high performance. To

obtain high performance on 75 meters, one must first get the radiating portion of the antenna as far away from the metal body of the automobile as is practical so you won't suffer from body absorption and the detuning effect it has. I used a Hustler tilt-over mast. I chose to use the long mast (the one they normally recommend to use for bumper mounting), and mounted it up on the rear deck adjacent to the corner of the rear window. The ideal place, from the standpoint of efficiency, would have been right in the center of the roof, but I have to keep peace in the family. This tilt-over mast measures 55 in. long. With the extra heavy-duty stainless steel base spring, it brings the length of the base mast to exactly 5 ft long. The total antenna length approaches 10½ ft. This puts the top of the antenna about 13 ft in the air. This is a lot of antenna up there, but if you want to get out you must have a lot of antenna out in the air and have it properly matched and tuned. While driving, in order to keep the antenna in a vertical position, which is also necessary to maintain antenna resonance, I slip a large nonmetallic washer over the top

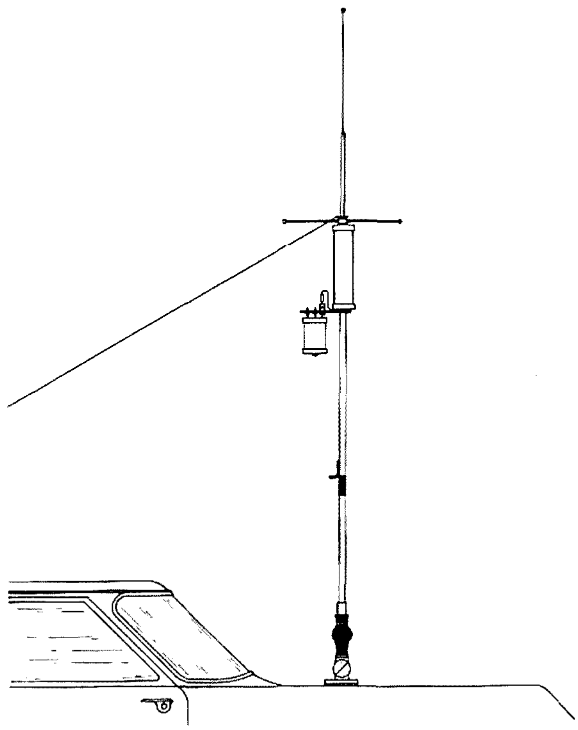

Fig. 5. Assembly and installation of 75m antenna.

section whip and let it come to rest on top of the loading coil. I drilled a small hole in one side of this washer. Through this hole I tie some waxed nylon lacing twine as shown in Fig. 5 and run it up forward to a gutter clip on the driver's side of the car. This is a very low-loss line and does not affect the performance of the antenna even when wet, because it is waxed.

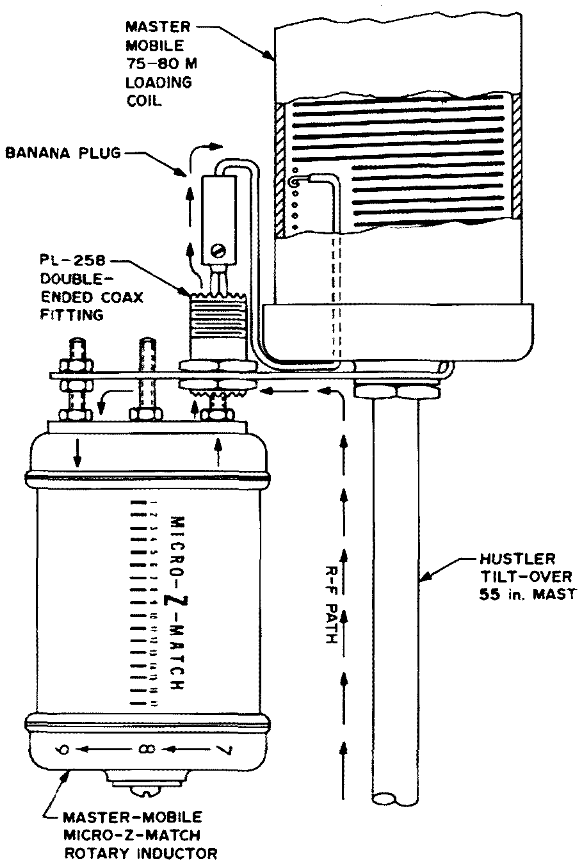

Fig. 4. Rotary coil detail.

Tuning the Antenna

Tuning this antenna was a relatively easy job. It would most likely have been a lot easier for me if I had used a grid-dip meter and an swr bridge, but I do not have either one, and I found out they were not really necessary. I tuned up this antenna using nothing but the cathode current meter on my transceiver and a field-strength meter. I am able to resonate the antenna in any 50 kHz portion of the 75 meter phone band with equal efficiency and still maintain the highest possible Q. It should be pointed out that most mobile antennas exhibit a feed-point impedance less than the characteristic impedance of the transmission line that feeds the antenna. You can match the feedline to the antenna by using a simple matching network. This network is composed of a

rotary inductor which we will call L_M and a capacitor which we use to shunt the feed point of the antenna to ground with, and we shall call this capacitor C_M. The required values of C_M and L_M may be determined from the following formula. (See Fig. 6.) R_A is the antenna feed-point impedance and R_O is the characteristic impedance of the transmission line. If the antenna impedance is 20Ω and the line is 50Ω coaxial cable and the operating frequency is 4000 kHz, the inductance is as shown in Fig. 7. The chart at Fig. 8 shows capacitive reactance of C_M, and the inductive reactance of L_M necessary to match various antenna impedances to 50Ω coaxial cable. In practice, L_M need not be a separate fixed inductor nor a separate

$$C_M = \frac{2\pi f_{KHz}\, R_O \sqrt{\dfrac{R_A}{R_O - R_A}}}{10^3}\ \text{pF and}$$

$$L_M = \frac{\sqrt{R_A(R_O - R_A)} \times 10^3}{2\pi f_{KHz}}\ \mu H$$

Fig. 6. Equations for obtaining C_m and L_m.

rotary inductor, but I chose to have L_M a separate rotary inductor to give me more latitude and flexibility in tuning, as I wanted precise matching and maximum performance over the entire 75 meter phone band. L_M can be duplicated by adding an equivalent amount of inductance to the loading coil. If you choose to have L_M fixed and a part of the main loading coil, C_M at least should be variable until the appropriate value of capacitance is found. When this value is found, fixed, high-voltage capacitors of the same value can and should be substituted. A rotary (variable) capacitor can be used if you can secure the shaft by locking it in place so it will not change capacitance due to vibration.

I first started tuning up the antenna at the low end of the phone band 3.8 MHz. I did this by extending the top section whip up and out all the way and setting the rotary inductor so the maximum number

$$C_M = \frac{(6.28)(4000)(50)\sqrt{\dfrac{20}{50-20}}}{10^3}$$

$$= \frac{(1256)(10^3)\sqrt{0.6666}}{10^3}$$

$$= (1256)(0.816) = 1024\ \text{pF}$$

$$L_M = \frac{\sqrt{20(50-20)} \times 10^3}{(6.28)(4000)}$$

$$= \frac{\sqrt{600}}{25.12} = \frac{24.5}{25.12} = 0.97\ \mu H$$

Fig. 7. Inductance equations

of turns were in use. I used my transceiver to supply rf. I injected just enough carrier to get some output, then began running the tap up on the main loading coil until I started to get some output indication on my field-strength meter. I ran this tap up one turn on the coil at a time, retuning my transceiver each time to maintain resonance. I located the point on the loading coil where maximum output occurred and then backed up a turn or two and soldered the tap in place. I then started lowering the top section whip until I again obtained maximum output as indicated on the meter.

Once locating this point on the top whip, I marked it by using a low-voltage dc power supply with its output set at around 20V, clipped the negative lead to the whip and the positive lead to a lead pencil. I

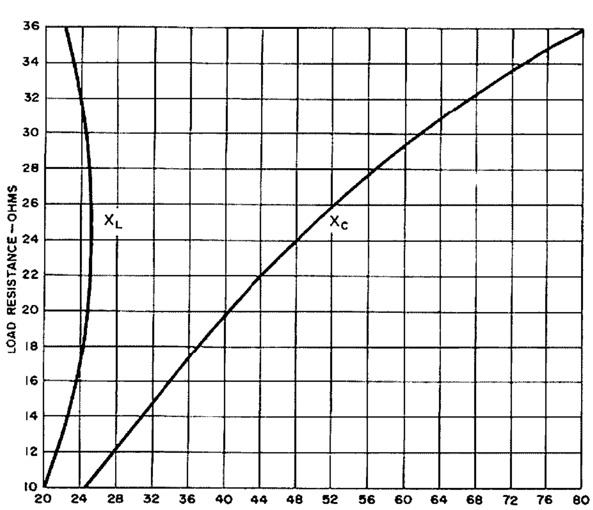

Fig. 8. Resistance-reactance chart.

touched the tip of the pencil to the whip where it resonated at 3.8 MHz and arced a ring around the whip. This mark is permanent and very easy to see. I then turned the rotary inductor all the way in and retuned the transceiver for maximum output. I found out that maximum output occurred at 3.85 MHz, 50 kHz up the band. I then ran the rotary inductor back to its original spot and retuned the antenna to 3.85 MHz by lowering the top section whip. When I again found resonance, I marked this spot in the same manner. I now had two marks on the top section whip, one at 3.8 MHz and one at 3.85 MHz. I tuned the rest of the antenna in the same manner. I now have electro-etched marks on the top section whip corresponding to 3.8, 3.85, 3.9, 3.95 and 4.0 MHz – the entire phone band. I can tune the antenna to exact resonance at any point in the phone band by raising up the top section whip to the lowest frequency mark below where I want to operate and tuning for maximum output on the desired frequency by rotating in the rotary inductor (reducing turns). In reference to the matching capacitor C_M, I shunt the base of my antenna with 1000 pF. I do this by using a ceramic rotary switch mounted on an angle bracket which in turn is mounted on one of the antenna body

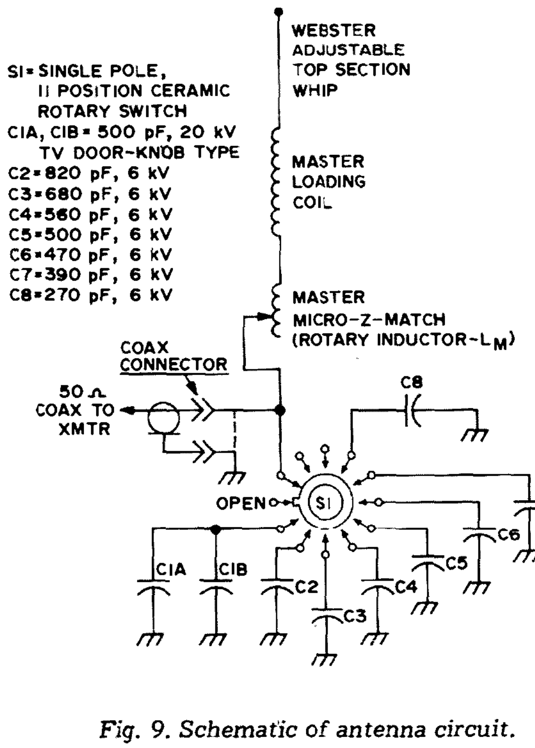

Fig. 9. Schematic of antenna circuit.

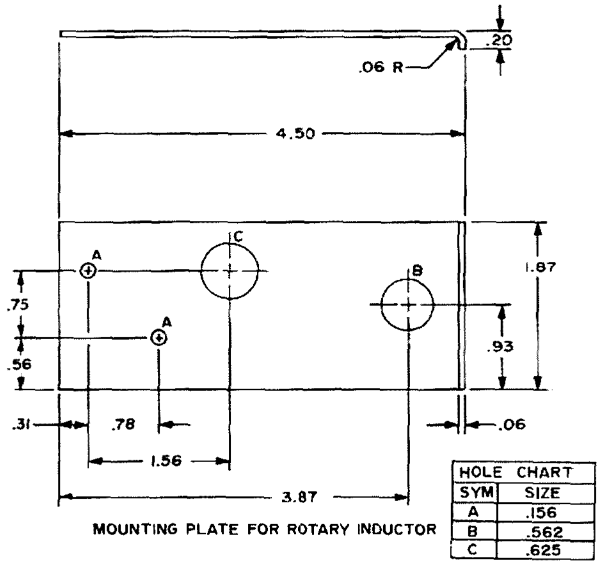

Fig. 10. Dimensions of mounting plate for rotary inductor.

mounting bolts. This switch is a single-pole, multiple position switch. On this angle bracket I mounted the ceramic rotary switch, my matching capacitors and a coaxial fitting (Fig. 9). I can select any of 10 different capacitors, all of different values. The antenna I use on 40 meters is of the same principle; adjustable top section; three-spoke capacity hat, and a large high-Q coil, but no rotary inductor. C_M for that band turned out to be 500 pF. Figure 10, by the way, is a template for the 75m rotary inductor mounting plate.

Results

The results I have obtained with this antenna have been beyond my wildest expectations. I can work anything I can hear. Ground-wave communication is excellent with little or no fade. To date I have worked many Atlantic Coast states with 5–9+ reports, many provinces in Canada, Alaska, Midway Island, Hawaii, Mexico, South America, and my latest ZL1BAZ in New Zealand with a 5–8 report. This antenna is terrific. I have only been able to work Hawaii from the QTH using the same power and a full half-wave inverted-V antenna; I've never been able to work any of the others. Contacts on 40 meters have been equally as good using the same system. In addition to the contacts mentioned, I've been able to work several KC4 stations in Antarctica. All contacts made were while I was mobile in motion.

W6MOG■

A DUAL-GATE FET PREAMP FOR 2 METERS

. . .an up-to-date circuit that offers high gain, excellent noise figure and simplicity

Clifford Klinert WB6BIH
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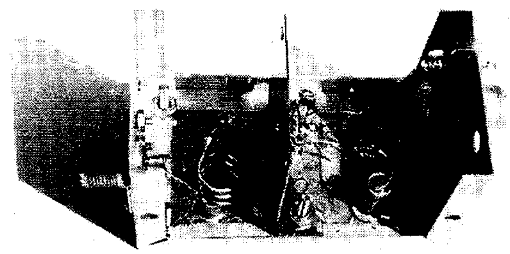


An rf preamplifier is a handy thing to have when there is a desire to improve the sensitivity of older receivers or to complete the construction of modern ones. The availability of dual-gate FETs makes it possible for the average experimenter to build a good front end for his receiver. This article describes such an FET amplifier that can provide about 20 dB of voltage gain to improve the sensitivity of fair or poor receivers. This preamplifier can also improve the signal-to-noise ratio.

The Circuit

Figure 1 shows the schematic of the amplifier. A common source unneutralized Motorola MFE 3007 is used. The input signal is applied to one gate, and the other gate is used for biasing. An rf choke and feedthrough bypass capacitor are used to improve isolation from the power supply. Experimentally tapped coils are used for input and output coupling.

Construction

The amplifier was built in a small aluminum box. The top was cut out and replaced with a copper plate, and a copper partition was soldered in the center as a

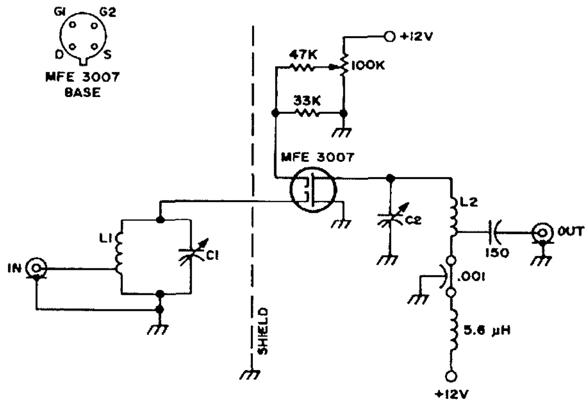


Fig. 1. 146 MHz rf amplifier.

shield. Both L1 and L2 were 3½ turns of 18-gage wire stretched to about ¾ in. long. The coils are ½ in. diameter. MC 603 trimmer capacitors were used for C1 and C2. They are 1–28 pF, but a variety of small variable types could have been used. The transistor was mounted on a clip in the center shield. L1 and L2 are mounted perpendicular to each other to minimize electromagnetic coupling. A 100 kΩ variable was mounted in the hole on the output side of the box, after the pictures were taken. Venerable UHF connectors were used for both input and output terminals. Since the MFE 3007 was susceptible to gate breakdown, all leads of the transistor were shorted together with a short piece of wire. The shorting wire can be just barely seen in the photograph. No problems were encountered with transistor damage, and when the wire was removed the amplifier functioned normally.

Adjustments and Operation

The first step in tuning was to set the tuned circuits approximately on frequency with a grid dip meter, then see that they tune above and below the desired frequency. Since an AM receiver was used, the avc was turned off, the audio gain was set at maximum, and the rf gain control on the receiver was used to control the output level. A modulated signal generator was used to obtain an ac voltage at the speaker terminals. A Ballantine VTVM with its good dB scale was used to measure the change in output signal. This setup makes it possible to estimate the gain of the preamplifier (assuming that the receiver was linear). With the gate bias set at zero, and a weak signal applied, all receiver rf circuits were tuned for maximum output.

The signal generator was placed about 100 ft away with a whip antenna attached. This precaution insured against stray coupling through the power lines and provided a simulation of actual operation since the station's usual 2 meter antenna was used.

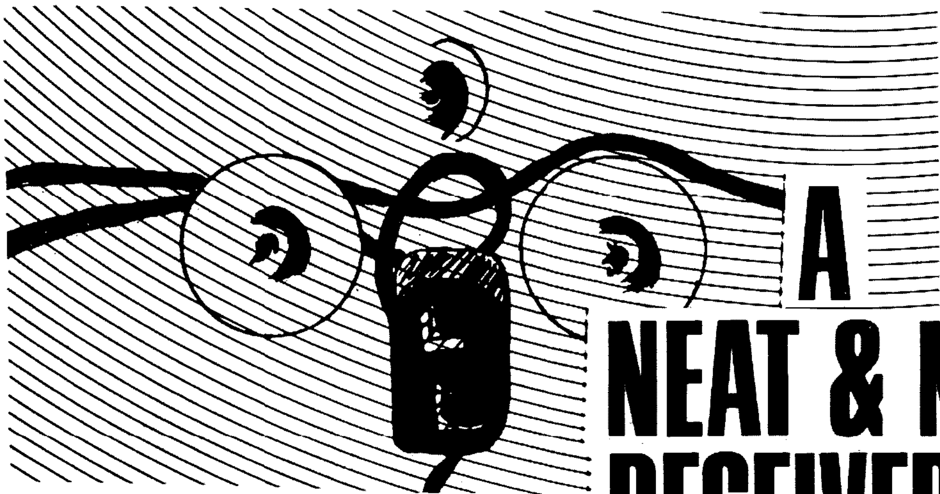
After the tuned circuits were set up with zero bias, the 100 kΩ pot was turned slightly to increase the bias. This caused generally a decrease in output, but retuning the tuned circuits, mostly C2, brought the output up to a point higher than it was previously. This process of increasing bias slightly and retuning was continued until the amplifier broke into oscillation.

The bias was then reduced to provide stability and all rf circuits in the receiver were tuned to assure stability and proper tuning. This bias point produced 0.6V at the second gate as measured with a VTVM. The receiver was peaked up at 146 MHz as a compromise between AM (145 to 146 MHz) and FM (146 to 147 MHz).

To measure the gain, the receiver was set for maximum output just before saturating the audio, and the output voltage was noted. Removing the preamplifier and putting the antenna back on the receiver resulted in dropping the output voltage more than 20 dB. A 50Ω dummy load was applied to the input of the preamplifier to check its noise output. This showed an increase of 15 dB noise in the receiver. During these tests it was found that the amplifier took a few seconds to warm up when power was reapplied. During this warmup period the gain increases slowly and stabilizes.

This preamplifier provided a good increase in signal gain that, in some cases, has meant the difference between Q5 copy on a weak signal, and just barely being able to hear it. The receiver used with it was adequate enough in hearing external noise and it seemed that an increase in gain would only increase noise; however, several new signals popped up from about a hundred miles away that were not noticed without the preamplifier.

. . .WB6BIH■



A NEAT & NOVEL RECEIVER ACCESSORY

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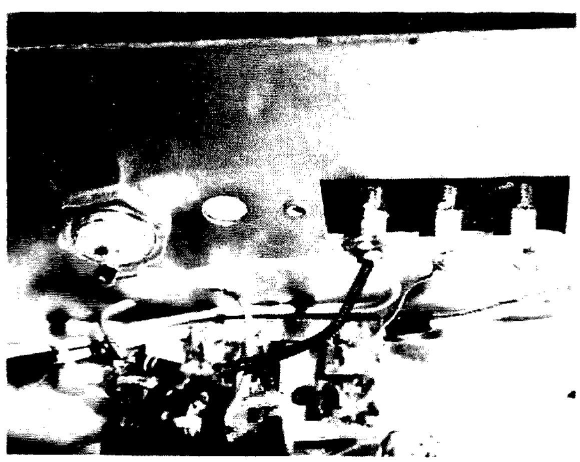
In the mid-fifties, I purchased a Hammarlund HQ-100 receiver. This is not the best receiver ever made, but it is not the worst either. The unit has served me well for the past few years, requiring only an occasional tube change to keep it working.

One accessory that is most useful is the crystal calibrator. This is inexpensive, and is easily installed even by the inexperienced in electronics. Since the dial calibration on this, as well as most other receivers, leaves something to be desired as to accuracy, the crystal calibrator finds it use in giving a marker at predetermined locations.

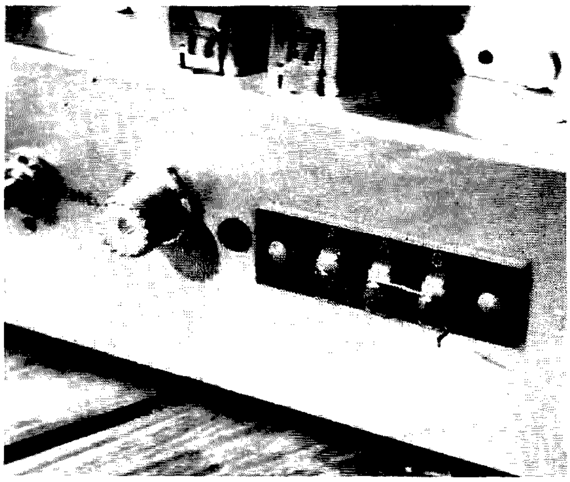
Let us assume we want to listen to a shortwave station at 15.175 MHz. The dial will get us to the right general area, but then we have to tune the bandspread all around, listening to about everything else on the band until we get to the right place – and even then we aren't sure until we hear an ID or a familiar announcer's voice.

The crystal calibrator speeds up the process. When the switch is on, a signal is produced every 100 kHz on the band as a "marker." Looking for 15.175, we first find a reference spot such as WWV, count

The B+ wire from filter capacitor to dropping resistor. Note terminal strip mounted in a convenient place.



Inside of chassis showing connection of coax receptacle. Third wire on antenna terminal comes from calibrator.



Rear of chassis showing coax connector installed.

the 100 kHz pips on the way up until we are at 15.170. Halfway between .170's pip and .180's pip is our station. Simple.

This is so useful when using the bandspread since the calibration of the main dial is then almost useless.

For my HQ-100, I purchased the calibrator direct from the Hammarlund factory. The various makes of calibrators are all basically the same, so just about anything, including the battery-powered model, would work in the circuit. The suggestions I have for mounting the calibrator would work almost the same way in any popular receiver.

This is an extremely easy thing to do, so that even the newcomer could perform the steps with a screwdriver and a soldering iron.

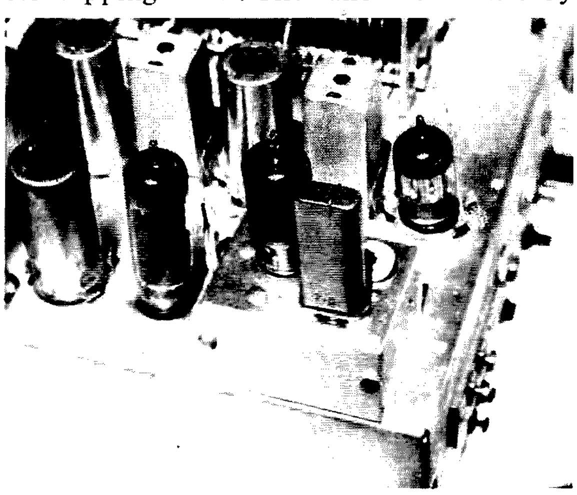
The Hammarlund calibrator comes with an on-off switch so that the unit will not be calibrating all the time (if you listen to a station on an even hundred, you will also get the calibration signal and this might be undesirable). The switch is in the B+ line to remove plate voltage from the tube when the calibration signal is not wanted. The switch can be mounted in any convenient place. I chose to mount mine on the front panel – but before doing any drilling, look around back to make sure you won't interfere with existing wiring or anything. The receiver's dials occupy a considerable portion behind the front panel; however, I located an area just large enough between them to mount the switch.

After the calibrator is mounted, it will have to be calibrated itself. Have the set warm up for at least a half hour so that all circuits reach operating temperature and there will be no drift. Tune to WWV, and wait until the tone stops and you hear only ticks. Adjust the capacitor on the calibrator to "zero beat." Wait another hour or so and check it again. It is best to use an insulated screwdriver for this process.

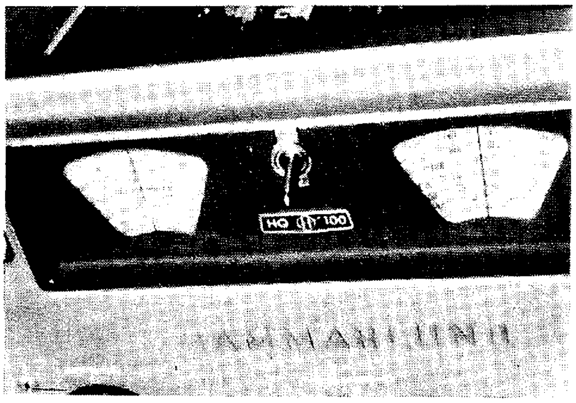
One other modification on my receiver is the installation of a coax antenna connector. Since I use coaxial cable for antenna leads, an inexpensive connector mounted in a spare spot on the back of the receiver is a great help. Drill a pilot hole where you want the connector to be, get it to the right size with a chassis punch, and you'll be in business. I used the type that requires only the single hole; the type that also requires the four holes for mounting can be used just as well – but this saved drilling four holes (and I never get them in straight anyway). Route a wire from the center connector to the antenna 1 terminal. A doublet antenna may still be connected to the terminal strip at any time; but for coax use, plug in the coax to the plug and short A2 to G on the antenna terminal strip.

I found a convenient spot on the chassis to mount the calibrator. The mounting position is not critical and can be almost anywhere. I tried to keep it away from the power transformer to minimize hum pickup.

Already drilled in the chassis was a hole which matched a hole in the little calibrator chassis – I lined these up and inserted a self-tapping screw. The calibrator is held by



Position of mounting crystal calibrator.



Front of receiver showing calibrator switch.

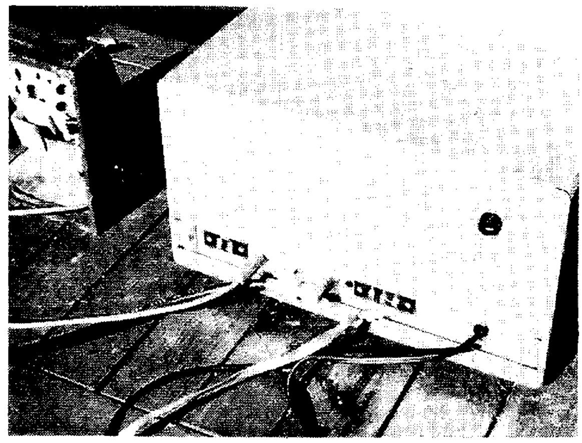
one screw, not two, even though a purist might shudder at this.

This calibrator had four long wires coming out of it. The instructions quite nicely told exactly what to do with each wire – filament, B+, antenna, ground – my only decision was where to route these leads.

Fortunately, there are enough small holes already drilled in the receiver chassis that it was not necessary to drill another. The filament lead was routed to the nearest tube and soldered to the filament connection on the socket. The ground wire went right next to it and was soldered to a nearby ground lug. The antenna lead, of course, connects to the antenna terminal on the back of the receiver chassis. This produces no degradation of service, by the way.

There are many points in the receiver where B+ can be obtained. I took mine right from the filter capacitor. The voltage here was a shade higher than the instructions suggested, although performance of the calibrator was entirely satisfactory. However, the higher the B+, the stronger the calibration signal – and it is not necessarily desirable to have a strong signal, since the bandwidth will be greater. So I looked through the spare resistors and came up with one of 4.7 kΩ and tried it in series with the B+. It works great, so I am leaving it alone. Probably any popular size would work as well from 3.9 to 150 kΩ. I located an ideal place to mount a terminal strip under the chassis, put the resistor between the terminals, and broke the B+ lead, installing the resistor in this lead.

Rear of calibrator on-off switch.



Rear of HQ100 ready for action. Notice 90° elbow on coax. Speaker plugs into phone jack – no change of impedance.

After using the radio almost fifteen years, I checked the alignment and found it to be off a bit. There was no problem aligning the unit, following the instructions in the manual, using a vtvm and rf generator. If you have these items, or could borrow them, there should be no problem in aligning this yourself and saving some cash. Maybe you could get friendly with a radio amateur or commercial broadcast engineer who would have you come over with your receiver and show you how it is done. When I first got going in the business, a fellow did this for me, and I learned how simple it is when you know what you're doing.

After installing the calibrator and coax connector, and aligning the receiver, the international bands come blasting in. Next project is to install a product detector, since receiving SSB signals using the bfo and fooling around with the rf gain on manual volume control is something less than satisfactory.

WA6CPP■

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THE HARTLEY OSCILLATOR STORY

A tribute to R.V.L. Hartley who, until his recent death, was one of the last of the real electronic pioneers.

Ralph V. L. Hartley, inventor of the Hartley oscillator, died on Friday, May 1, 1970, at Overlook Hospital in Summit, New Jersey. He was 81 years old.

Ralph Hartley graduated from the University of Utah in 1909 and studied for the next three years at Oxford University as a Rhodes scholar. After returning from England, he joined the research laboratory of the Western Electric Company.

Early in 1914, the transcontinental telephone line was near enough to success that the chief engineer of AT&T began to seek new fields to conquer. Radio seemed promising and so Ralph Hartley was asked to look into the matter. Soon experiments were going on and within the year Ralph Hartley invented the famous oscillator circuit that bears his name. The earliest known drawing of the oscillator circuit is shown in Fig. 1.

Also during this period, Hartley invented a neutralizing circuit to offset the internal coupling of triodes that tends to cause singing. He soon became the acknowledged expert on receiving sets and when tests were made from a transmitter connected to the Navy's antenna at Arlington, he was listening in San Francisco.

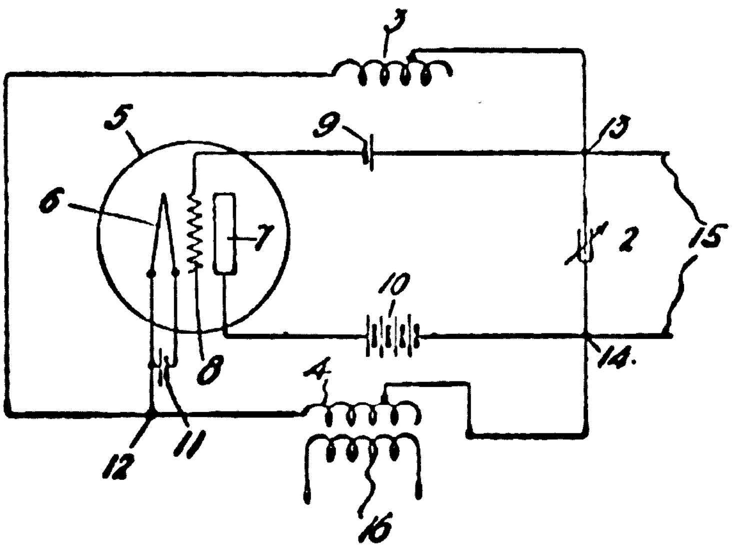
During World War I, while working on the problem of binaural location of a sound source, Mr. Hartley formulated the now-accepted theory: that direction is perceived by the phase-difference of sound waves due to the longer path to one ear than to the other.

Following the war, Mr. Hartley was placed in charge of research concerning repeaters and voice-and-carrier transmission systems. This work was first carried out at the Western Electric Company and later at Bell Telephone Laboratories.

During the next decade, his keen imagination and skillful guidance carried the art a long way. Many early models of voice-operated devices were made in those days; one was the vodas, which prevents sing-around in long 4-wire circuits. Mr. Hartley fostered the treatment of telegraph pulses by Fourier analysis so that ac measurements could be used in telegraph transmission studies. In an attempt to secure some measure of privacy for radio, he developed the simple frequency-inversion system.

In 1923, Mr. Hartley published a pioneering paper which set forth the relation of the carrier and sidebands in radio transmission and discussed the many advantages of single-sideband suppressed carrier transmission. The telephone companies soon adopted SSB but it was not until the amateur, in the years following World War II, popularized the mode, that other commercial organizations and the military saw its many advantages.

At about this same time, selective



Hartley's oscillator as it appears on his patent granted Oct. 26, 1920. It took more than 3 pages of very small type to describe the operation of the oscillator. The device, granted patent 1,356,763, was called an "oscillation generator."

filters were being developed and it was Mr. Hartley who first analyzed the mechanical filter and discussed its many advantages.

Broadly, however, Mr. Hartley's contribution was the intangible one of clarifying ideas and arranging them into a useful pattern. Nowhere is that talent better seen than in a paper entitled "Transmissions of Information," presented at an international conference at Lake Como, Italy, in 1927, which brought together a lot of ideas that had been implicit in the thinking of transmission men. Here he enunciated the law, later to be known by his name, "The total amount of information which may be transmitted over a system is proportional to the product of the frequency range which it transmits by the time during which it is available for the transmission."

After a period of failing health had halted Mr. Hartley's active work, he returned to Bell Laboratories in 1939 as a research consultant on transmission problems. He continuned in that capacity until his retirement in 1950.

During his active career, he received many awards and honors, including the Medal of Honor of the Institute of Radio Engineers, and fellowship awards in the Institute of Electrical and Electronics Engineers and the American Association for the Advancement of Science.

He was awarded 73 patents for his pioneering inventions.

Although never himself an active ham, he was well aware of the activities of amateur operators and was proud that many of his contributions had found acceptance in this group. In 1968, he was honored with a life membership in the New Providence (New Jersey) Amateur Radio Club, and only recently the Board of Directors of the Antique Wireless Association voted him an honorary membership.

After his death, the following resolution was unanimously passed at the New Providence Club:

> *The officers and members of the New Providence Amateur Radio Club, Inc. note with profound sorrow the death of Ralph V. L. Hartley, an honorary life member of this organization.*
>
> *The many contributions in the field of electrical communications made by Ralph Hartley will continue to influence the entire scientific world, including that of amateur radio, for years to come, as they have in the past. We are thankful that he used his time on earth for such inventive activities.*
>
> *His death is a great loss to us and to the entire amateur radio fraternity.*

K2SKV■

The Widening World of Instant Replay

Like the sports fan watching an "instant replay" of a television touchdown, the \$100,000,000 closed-circuit videotape recording industry is benefiting from a second look at itself.

Just over four years ago, compact inexpensive videotape recorders emerged to vitalize the closed-circuit television industry that serves education, business, industry, medicine, government, sports and many other fields. Their role in this diverse market is coming into clear focus after four years of rapid growth.

Born out of the needs of the broadcast television industry, refined and matured through demanding daily use in schools and colleges, business training centers and a host of other environments, the videotape recorder is on the verge of becoming a practical home entertainment device.

The versatile videotape recorder records moving pictures and sound on magnetic tape for immediate and repeated playback. Ampex Corporation, Redwood City, California, developed the first practical videotape recorder in 1956. It was large – more than 1,000 pounds – and expensive, and was designed exclusively for use by television networks and stations. Most television programs seen today are broadcast from successors of this type of videotape recorder.

The 1966 introduction of low cost, portable VTRs – weighing less than 100 lb and priced from approximately \$1000 – unlocked the door to a vast number of potential users and stimulated the use of closed-circuit television in many fields.

More than 65,000 low-cost videotape recorders have been placed in service throughout the world in the last few years. Industry sales of small VTRs have grown from approximately \$15 million in 1966 to \$40 million in 1970, in addition to an estimated \$60 million in related accessories. By 1975, Ampex estimates annual sales of compact videotape recorders, accessory equipment and software for serious closed-circuit use will be approximately \$200 million, not including home or consumer use.

As this market has grown it has developed identifiable patterns of use and equipment requirements. Three broad subdivisions of the market have emerged:

Repetitive programming. This is the requirement of the professional closed-circuit television user who wishes to produce quality programs on video tape for wide distribution and frequent playback. As such it calls for two distinct kinds of equipment – high-quality versatile production recorders and simple, inexpensive playback units. Schools and universities, business, industry, and government agencies are typical users in this area. Ampex videotape recorders using 1-inch-wide tape with electronic editing, special effects, and guaranteed interchangeability from machine to machine are the leaders in the production portion of this market section.

Semirepetitive programming. In this category production sophistication, electronic editing, and studio techniques are less important; economy and portability are more important. Classrooms and small training centers are typical markets.

Instantaneous response. In this category, the value of the information recorded is in the immediacy and convenience of the presentation, with little or no concern for future use or distribution. Portability, economy, and simplicity are the major factors. Recorders using the 1/2 in. format dominate this market. Applications are extremely varied and embrace a wide range of fields.

Two portions of the closed-circuit VTR market are expected to experience the most rapid growth in the next few years. One is the *instantaneous response* category, the other the *distribution portion of the repetitive programming* segment. These fields both call for compact, economical, and easy-to-operate equipment.

The market for high-quality production equipment for the repetitive programming segment of the market will continue to grow as the emerging compact distribution recorders make the playing of recorded presentations more simple and economical. High-speed tape duplication systems now under development will similarly stimulate both the use of production recording equipment and distribution playback devices.

It is from product developments for the distribution and instantaneous response portions of the market that the long-awaited home videotape recorder/player will most likely emerge. The same basic requirements sought for these uses will be demanded in even greater degree by the consumer.

As a recording device, the home videotape recorder must be extremely compact and inexpensive. It must be at least as easy to operate as a cartridge-loading movie camera and provide color recording capability as well as monochrome. For playback, it must be as easy to load as a cartridge or cassette audio recorder.

Developments by Ampex and others in this direction indicate that a true home videotape market, which presently does not exist, may well emerge in major proportions over the next several years.

The contenders in this emerging field are arrayed in two basic camps – those that propose playback-only systems for viewing recorded entertainment through home television receivers and those that propose systems that not only play previously recorded material but can record at home, or anywhere, or tape programs off the air. Ampex is in the latter camp.

"We believe the forthcoming home market will best be served by equipment that not only plays back cartrid loaded recordings but permits completely portable or off-the-air recording as well. We are confident that this can be combined in a videotape system completely competitive in cost with any of the playback-only systems presently proposed," says William E. Roberts, Ampex president.

What is a Videotape Recorder?

A videotape recorder records moving pictures (color or monochrome) and sounds on reels of magnetic tape much as a conventional audio tape recorder records sound.

Audio tape recorders record sound either from microphones, from a radio receiver, or by duplication from another recording. Similarly videotape recorders record television pictures from a television

The new Instavision recorder/player uses standard half-inch video tape enclosed in a small circular plastic cartridge. The cartridge-loading system is the smallest to date. The cartridge is compatible with all reel-type recorders using the Type 1 half-inch standard. The blank cartridge will hold up to 30 minutes of recording time at the Type 1 standard or 60 minutes in an extended-play mode. Instavision recorders and players operate from internal batteries or household current, in color or black and white.

camera, from a television receiver or by duplication from another recording. In addition, sound tracks on the video tape itself permit audio recording from microphone or television set on the same tape with the television pictures.

In both audio tape recording and videotape recording, the basic method is the same. Sound or visiual images are converted to electrical signals by a microphone or camera. The electrical current varies in direct relationship to the sound or picture and produces a comparable varying flux in an electromagnet (the recording head).

A plastic tape coated with iron oxide is passed through this changing magnetic field. The iron oxide particles on the tape are thus magnetized in specific patterns which correspond to the original sound or picture. When the process is reversed, and the electric signal detected from the tape is amplified through a speaker or television tube, the original sound or picture is reproduced.

Just as with the audio recorder, videotapes may be played back immediately without processing by connecting the videotape recorder to a television set. Recorded tapes may be erased on the recorder, in part or entirely, and reused hundreds of times without loss of quality.

Of the various devices proposed for use in closed-circuit television applications in the home and elsewhere, only those using magnetic recording techniques are capable of *recording* and playing back pictures and sound. Those not using magnetic recording are *playback only* machines. These playback only devices are limited to playing programs previously recorded on complex specialized systems.

Instavision videotape recorder/player system includes a miniature videotape recorder, a hand-held camera, and a cartridge using half-inch video tape. It is said to be the smallest cartridge-loading video recorder or player system. Pictures may be played back for viewing on a standard television set. Initially, the entire system (less monitor) will be priced under $1500. Tape cartridges will be priced under $13 for up to an hour of recording. The system may be operated by batteries or household current, in color or black-and-white.

Audio tape recorders provide high fidelity stereo music at frequency responses up to 18,000 hertz. Much higher frequencies are required to record television pictures. Ampex studio videotape recorders for the broadcast industry record at more than 5 MHz.

Frequency response is directly related to the speed at which tape moves past recording and playback heads. In audio recorders, tape moves past the heads at 7½ in. per second, the accepted standard speed for high quality performance. In making the transition upward from audio recording frequencies to video recording frequencies, engineers have successfully used two basic

New Ampex Instavision system is the smallest cartridge-loading videotape recorder/player. It is designed for home recording and playback as well as serious close-circuit television use. The hand-held camera weighs 5 lb and the recorder/player, which can be carried with a shoulder strap, weighs less than 16 lb — including batteries for portable operation. A trigger built into the pistol-grip handle enables one person to operate both camera and recorder. The recorder may also be operated with household current for recording and playback in color or black- and-white.

techniques to increase the relative tape to head speed. A third method has been tried unsuccessfully.

Transverse recording. In 1956, Ampex created the rotary recording head and a technique called transverse recording. Video tape is moved past recording heads at 15 or 7½ in. per second. However, four record/playback heads are mounted on a disk which is rotated rapidly across the tape at virtually a 90-degree angle to the path of the tape. In this manner, the "relative" tape speed is increased effectively to 500 in. per second. At this speed, frequencies of more than 5 MHz may be achieved. Such frequencies produce television pictures with the color and monochrome quality necessary for broadcasting. Virtually all videotape recorders used for broadcasting throughout the world employ the transverse approach.

Helical recording. In 1963 a new generation of smaller recorders for closed-circuit use was introduced, utilizing the helical-scan principle. In this case, one or two record/playback heads are mounted on a rotating scanner and record a series of diagonal tracks across the tape. Actual tape speeds vary from 3.75 to 9.6 in. per second. Tape widths vary from a ¼ in. to 2 in. In this manner, relative tape speeds of from 280 to 1000 in. per second are produced, which allow frequencies of up to 4.2 MHz. In some instances, broadcast quality and color recordings are possible at these frequencies. Nearly all videotape recorders used in closed-circuit television are helical scan recorders.

Longitudinal recording. Since the 1950s various attempts have been made to develop videotape recorders using the same longitudinal recording technique used in audio and instrumentation recording. None have produced satisfactory quality. In this method, tape is moved at very high speeds past stationary heads which record parallel to the tape path. Even at tape speeds of more than 100 in. per second, frequency response of only 1.5 MHz has been attainable. This provides unsatisfactory picture quality and, coupled with a high consumption of tape for a small amount of recording, has prohibited development of a successful longitudinal videotape recorder.

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Design Concepts For Low-Power Amplifiers

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The purpose of this article is to review the present capabilities of transistors for low-power amplifiers and to note some recent circuit developments which have given designers more efficient systems. Two developments will be discussed: A new circuit viewpoint that emphasizes the function of the circuit; and a new family of devices which was designed for low-power complementary amplifiers.

Gain Characteristics

In the past, small geometry silicon planar transistors have not had good high current h_{FE} characteristics. The PNP's have been especially poor because of their inherently higher saturation characteristic. This situation has now changed with the advent of the two silicon transistors illustrated in Fig. 1. These new products are competitive in both performance and cost with germanium medium-power complementary transistors. The curves in Fig. 1 compare the worst case h_{FE} I_C loci for the new (upper curves) and the old silicon (lower curves) devices. The improvement is obvious. The new NPN and PNP transistors adequately fulfill the transistor h_{FE} requirements.

Power Dissipation

In a small-geometry transistor for class B audio applications, the rated dc dissipation serves as a guideline for average junction temperature calculations based on the thermal resistance of the package and the heatsink used. The low-cost requirement usually dictates the package design and resulting dc power dissipation capability. An important property that is built into these new device package combinations for class B applications is the ability to dissipate power on a repetitive transient basis. This property may be defined by the "pulsed safe-operating area" of the transistor.

Fig. 2a shows the safe area for a metal conversion of these new transistors at a case temperature of 70°C, with the dc curve indicating the average thermal power limitation. The pulsed power curves demonstrate the transient capabilities of the device. It is clear that a significant difference exists, and that a much higher power may be dissipated on a transient basis. These pulse curves will vary as a function of the case temperature and package for any given transistor die type. Fig. 2b shows the same data for an epoxy version of the new silicon transistors.

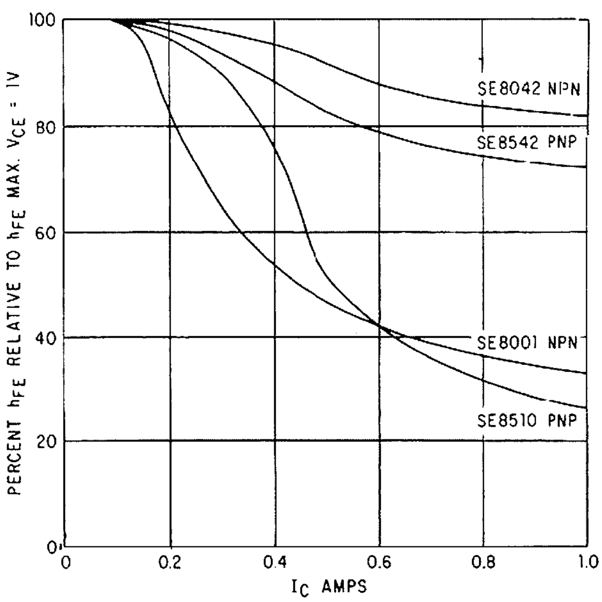


Fig. 1. Beta linearity vs collector current.

The 5 ms 50% duty cycle curve shown in Fig. 2b should be adequate for most audio applications involving repetitive low-frequency signals. The 1 ms 10% duty cycle curve is valuable in evaluating high-energy transient phenomena in switching applications.

Use of Safe-Operating Area Curves

Load lines for the output transistors in a complementary amplifier should be determined for various frequencies. This is necessary in order to make a realistic appraisal of the transient power to be dissipated by the output devices. This is best done empirically.

Fig. 3a shows a typical 1 khz sinusoidal load line for an amplifier operating from a 28 v supply into a 16 ohm resistive load. At 60 hz, as shown in 3b, the load line indicates that the transistor must dissipate considerably more power at V_{CE} of 15 v than in the 1 khz example. This is caused by the phase shift due to the output coupling capacitor. If the load line exceeds the safe area curve for a time longer than the specified period, the design should be considered unreliable, and appropriate action should be taken to reduce the power dissipated to a lower level.

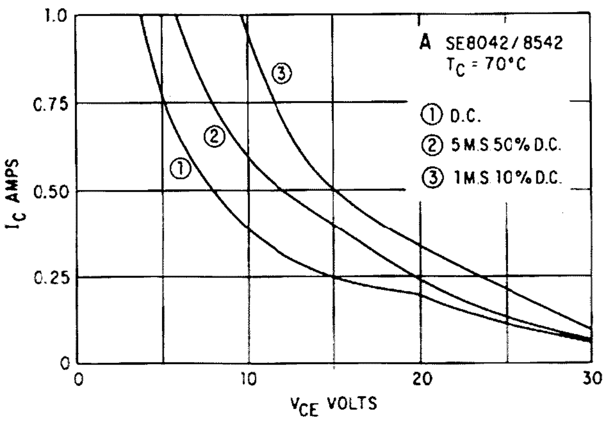


Fig. 2a. Safe operating area.

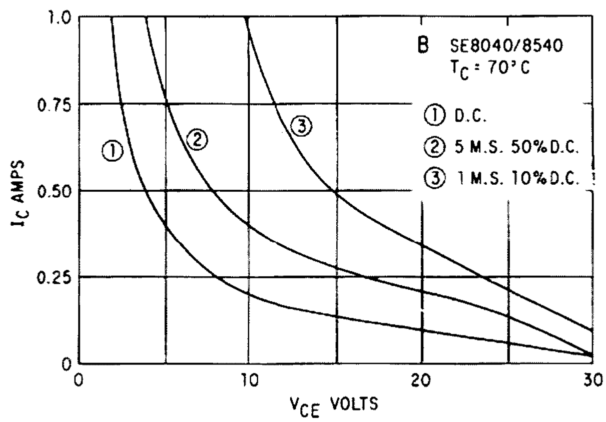


Fig. 2b. Safe operating area.

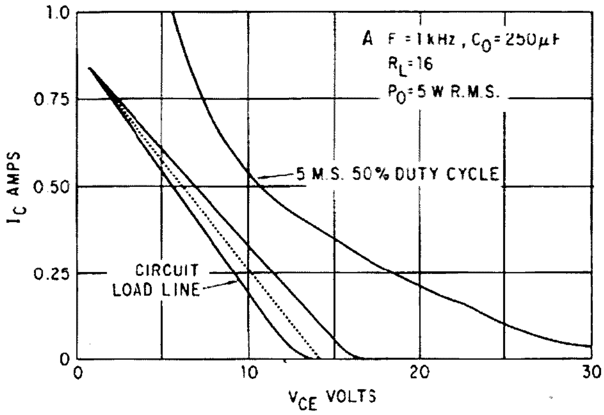


Fig. 3a. Load lines.

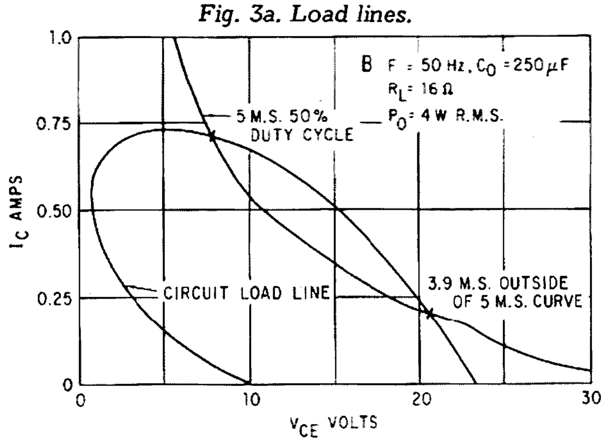


Fig. 3b. Load lines.

The General Amplifier

The low-power complementary amplifier (Fig. 4)) has been in use for three to four years. This amplifier was used initially (in a variety of forms) to replace the class A vacuum tube output stage. The basic circuit has been described in the literature on many occasions, usually superficially, and often without understanding the transistor characteristics and problems. Frequently circuits have been designed with fundamental failure modes. It is appropriate to list some of the fundamental design problems. These problems have little to do with how an amplifier sounds. Rather, they are problems relating to reliability of the amplifier.

1. Output Capacitor Charge and Discharge

There should be some way to keep the charging current for the output capacitor to a "safe" level for turn-on, turn-off, switching transients, etc. C2 of Fig. 4 must be charged by R1 before any current can flow in Q1, Q2, or Q3. This time constant should be long enough to keep Q3 within its dissipation ratings. On turn-off, C4 discharges through C3, R5, R6, and R_L instead of Q4.

2. Power Dissipation

The output transistors should be operated

within their dissipation rating. Since the amplifier's output transistors are operated without bias, the amplifier is a minimum dissipation circuit. This makes the total dissipation capability of the transistor available for signal conditions.

3. Bias Circuit

The method of bias used in this amplifier is not the only one, but some stable biasing circuit must be employed. Most failures occur simply because the circuit in the amplifier is not thermally stable. A bias circuit must have a very low terminal impedance, it must be thermally compensated for the shift in V_{BE} vs. temeprature, and it must be adjustable for the variations in output transistors. The alternative is to operate the output transistors without bias, the method chosen in this design.

4. DC Operating Point

The operating point of the output should be well defined and temperature stable. The temperature coefficient of an amplifier is set by its dc gain and the temperature coefficient for the gain stages. One very useful way to insure negligible drift is to make the dc gain unity. If this cannot be done, as in the circuit shown, then an upper limit must be imposed on the gain. For this circuit a gain of 20 db will give a shift of 0.6 v of the dc output level for a temperature shift of 25 to 55°C. The tolerance of the initial dc voltage should be established without depending on the transistor parameters. The tolerance on the resistors setting the output voltage should be close enough so that the output dc does not vary significantly from unit to unit.

The above problems are not the only ones associated with the design defects, but they are the ones which have been the subject of recent questions.

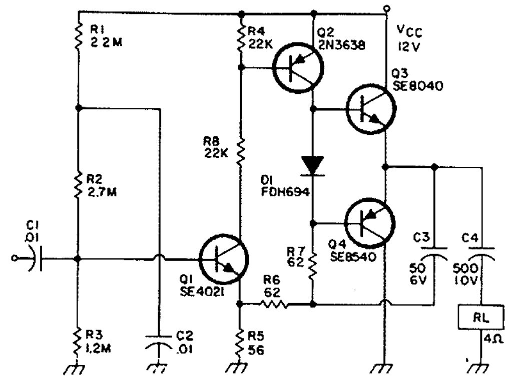


Fig. 4. Gain linearity is unimportant for distortion determination because of feedback.

Circuit Problems

The function of these amplifiers is to supply sufficient power gain to a system to drive the transducer. The amplifier should be reliable, reproducible, inexpensive, and should meet the required performance. Any circuit design which satisfies those goals is, by definition, a good circuit. Requirements differ, but virtually all the circuits operate in the current mode. The output transistors are operated from some form of current source, whether it is a resistor bootstrapped by the output capacitor or by a separate capacitor from the output into the collector load of the driver stage. In most circuits current gain and current gain linearity have significance due to the system power gain requirements and the amount of available feedback in the system. In the circuit of Fig. 4, gain linearity is not important in determining large signal distortion of the amplifier because the amount of feedback is sufficient to reduce gain non-linearity to a second order problem.

One point should be made about the output circuit. The output stage is driven from a voltage source for signals below the output transistor dead zone and the load current is supplied by Q2. The signal at the output is attenuated from the base signals of Q3-Q4 by the ratio of R7 to R_L. The output dead zone can be calculated by noting the load current required to change the current in R7 enough to reach the threshold of conduction for the output transistors. This would explain why the low-level distortion is not dependent on the load. The non-linearity at low levels in unbiased circuits can be improved by replacing the bootstrap with a transistor current source. This would maintain the forward gain at a high level even in the dead zone. However, this is a more expensive method of current sourcing and probably is not justifiable in most designs.

Conclusion

This article has discussed some of the problems associated with the design of low power complementary amplifiers and has presented material that should help eliminate present design defects and make future designs safer a nd more reliable.

. . . David Campbell & Richard Westlake

the price of 10 extra feet

The big day had arrived. My borrowed gin pole was still tied to the door handles of the Rambler in the driveway. The 10 ft section of tower lay on the floor of the garage. The job that lay ahead was pillow-plotted many times. The idea was to add the additional section to my 40 ft tower without the time-consuming disassembly of beam, rotor, and associated components. I was going to remove the top section complete with rotor and beam and lower it to the third section where it would be lashed up. The new section would then be raised and put in place.

My friend Jim came driving up shortly after the arrival of my nephew, Elliot, who had offered to help. Jim, K9TRJ, had heard my plan many times, but I took 10 minutes to outline the strategy to my 14-year-old nephew. The youngster, suffering the results of an extended adolescence, is six-foot-three of uncoordinated youth – willing, but sometimes inclined to release when he is asked to pull. Jim, on the other hand, is wise to the ways of hamdom, but is somewhat prone to rope-burn.

Eagerly, I scampered up the tower. Getting the bolts out of the top section was a cinch. Getting the gin pole up and securing it presented no difficulty either. On the third trip I carried up the tire jack from my Mustang. An advisor at the local radio store said this would be the ideal tool to get the sections apart. I secured the jack to one of the iron angles of the tower with a length of wire; just in case it got away. I wouldn't want to strain family relations by permanently brain-damaging my nephew with a falling jack. I began to jack and watched the sections part as the boys grunted below. The ground crew made an attempt to lower the section smoothly, but their hand-over-hand methods produced a convulsive jerking of the section. Finally, it reached the third level and I hurriedly tied it up with a tangled bundle of 14-gage electrical wire, a commodity on which I was long.

Getting the shiny new section in place was comic relief, but going up for the fourth time was beginning to tell on my 39-year-old legs. After tightening the new bolts in place and resetting the gin pole to the top section I returned to terra firma and the three of us settled down to grilled cheese sandwiches and milk. We held a luncheon postmortem on the morning's accomplishments and agreed that the hardest job remained. Elliot was thoughtfully silent as he downed 3 sandwiches which he chased with 2½ glasses of milk.

Returning to the task at hand, I climbed back up the tower and shouted down to Elliot and Jim to make the rope taut while I unwired the top section. As the assembly swung free I heard a distinct grunt from below and realized that the boys were having a bad time holding on. I was watching a double hernia in the making as they groaned, inching the assembly as the rope strained. We discovered that the top section was tied too high up with the gin-pole rope and it had to be brought back down to the ground and retied. By the time we were finally done I was literally shaking from exhaustion and hated myself for not having tackled the job in a normal manner. My ground crew had a few ideas about my engineering ability too, I'm sure.

I'd like to say that this was the beginning of DX and solid QSOs but that isn't how it went. A shorted coax connector (because of a hasty solder job) necessitated three more trips up the tower in successive days. Despondency was the prevailing mood until the trouble was discovered.

But was it worth it? Does 10 ft make a difference? Would I do it again? Yes, yes, yes. But not *that* way!

. . .K9PYY■

A TRANSISTORIZED 10 METER DSB TRANSMITTER

by Roland L. Guard, Jr. K4EPI

The DSB transmitter described herein uses crystal control and runs 1 watt or so, which can be used barefoot or to drive an rf amplifier.

The unit should be assembled in a small minibox or built on perf-board or PC board and then installed in a small minibox, as stray hand capacitances can upset the carrier balance.

The transmitter consists of speech amp, carrier oscillator, balanced modulator, and PA stages.

The amount of carrier suppression available with a diode-type balanced modulator is −40 dB.

Care should be taken in selecting the diode pair. Check the forward resistance of several diodes with your VOM until you find two with the same or nearly the same forward resistance. Germanium diodes were used in this unit which were in a grab-bag pack of 50 for $1 from Poly-Paks. The diodes should read at least 10:1 (forward-to-reverse resistance ratio).

Capacitors C2 and C3 are 30 pF variables. Cb is a variable, and capacitor C1 is a 4–30 pF trimmer. Coils L1, L2, and L3 are ¼ in. slug-tuned types removed from a TV PC boards many types of these coil forms

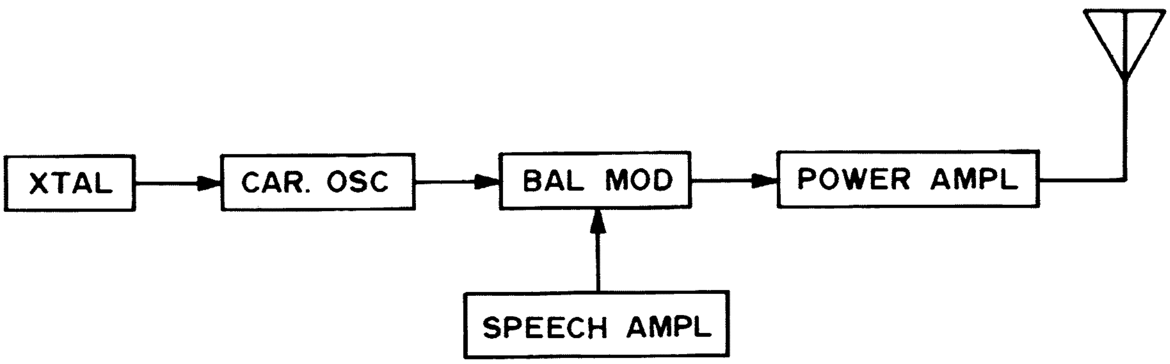


Fig. 1. This block diagram shows the simplicity of the homebrew 10m DBS transmitter. The tenth-watt unit can be used to drive a low-power linear or, for QRP fun, it can be used barefoot.

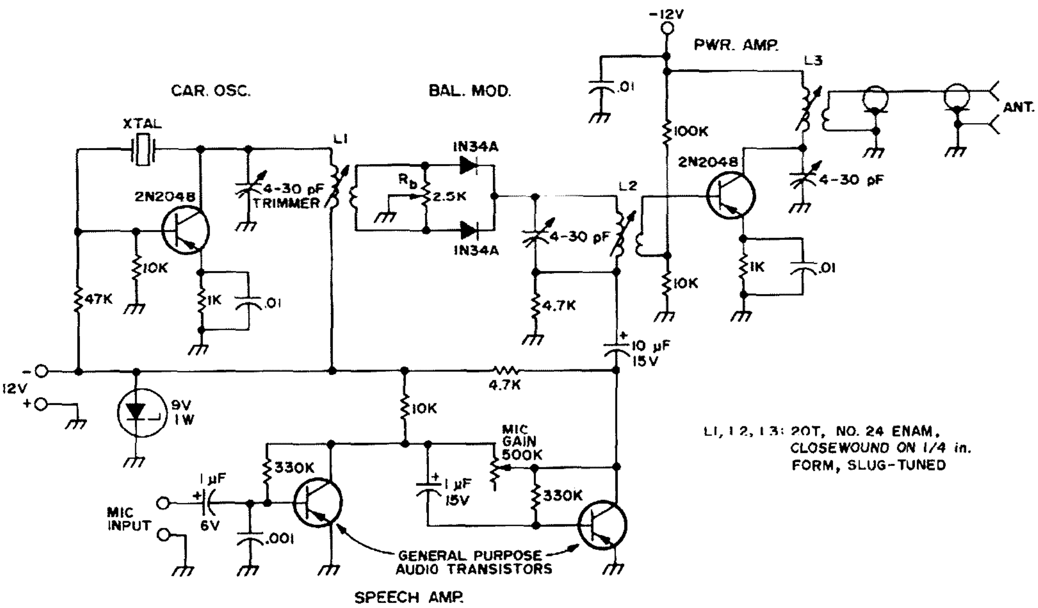


Fig. 2. Schematic diagram of DSB transmitter for 10m.

were tried and, although the ferrite slugs vary in Q, all coils resonated at 10 meters by juggling the slugs and tuning capacitors settings.

After checking the transmitter for operation by listening for the signal on a receiver, peak L1 and CI for maximum S-meter strength. Then null out the carrier (minimum S-meter indication) with pot R_b. L2 and C2 may also be varied to null out the carrier. With the carrier nulled out, speak into the microphone with the mike gain control half open. You should be able to hear the double-sideband signal in your receiver. Next adjust L3 and C3 for maximum output.

At the home station, I use an RCA WO-88A oscilloscope to monitor the 50 kHz i-f strip in my Mohawk receiver. Observing the scope with the signal tuned in on 10 meters makes balancing the carrier a cinch. If you don't have a scope, monitoring your S-meter is sufficient.

On my scope, the carrier suppression of this transmitter is sufficient to put it way below noise level on the 10 meter band.

The carrier balancing adjustments should be carried out with the rig installed in its minibox, cover on. Small holes should be drilled in the appropriate places for adjusting the coils and trimmers. Changing crystals may upset the carrier balance and you will have to make the balance adjustments again. A few times and this becomes child's play.

Today's receivers can receive a DSB signal with no difficulty. Most of the time, operators will not be aware you are using DSB. This rig could easily drive a 6146B which would give you about 100W PEP.

This rig can also be used on any other band by changing the coils and crystal. To do this, "borrow" coil data from other published articles for the band you want. A homebrew vfo could also be built for this rig. This rig could be made into a walkie-talkie or hidden in the glove compartment of a car. It would be just the thing for talk-in at hamfests.

You can squeeze more power from Q2 by reducing the resistor values shown or by applying more voltage to Q2 collector (not to exceed the rated voltage for the particular transistor you use). However, you could also drive Q2 into a nonlinear operating condition. For DSB, as in SSB, you must operate the PA in its linear operating zone.

By turning the R_b balance pot to either side, you can use low-level AM. K4EPI■

REVIEWING THE 1971 RADIO AMATEUR'S HANDBOOK

Douglas Stivison WB2MYU

You might say that The Radio Amateur's Handbook is crystal controlled – very little drift from the standard. Year after year the Handbook appears with basically the same format, pictures, tables, and charts. As a guide to the avant-garde in ham technique and construction, the Handbook is certainly lacking. Yet it remains the cheapest and most popular handbook of standard amateur construction and communication techniques.

I built my first CW rig from the Handbook, and my first VHF project, and my first homebrew test equipment, and I used its tables to put up my first antenna, and to figure out the color codes on all those weird surplus components. Dog-eared and smudged illegibly on the dozens of oft-used pages, with burn holes from hot solder globs, and with schematics traced in pencil, my 1963 Handbook has been consulted countless times. I've built no less than six rigs from it. I've never purchased a newer Handbook because the book just doesn't change much from year to year.

However, I think I might invest in the 1971 Handbook.

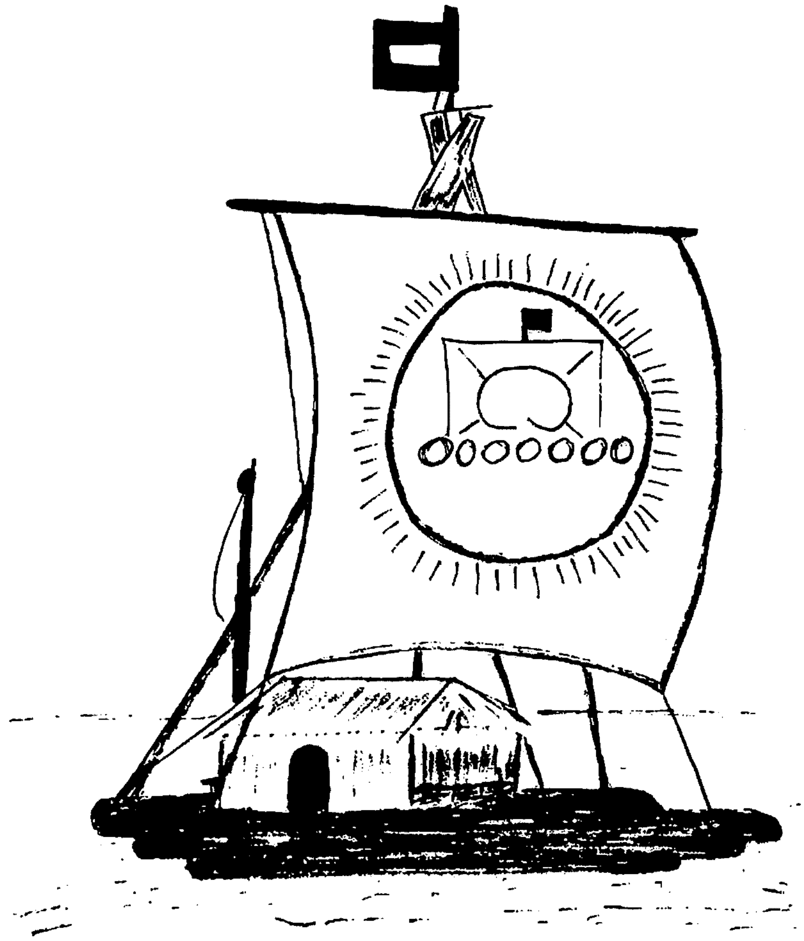
The Handbook, printed this year on off-white nonglare paper, is not the guide for the experimenter using the newest components and techniques. Rather, it is a compendium of standard circuits and immutable tables and charts. It is the ham's, if not the engineer's, reference for the time-tested circuits and the time-tested techniques. The majority of its projects have been fabricated time and again by hams. I have never built anything from the Handbook and had it work the first time – but every project has worked eventually. For the standard Q-multiplier, mixer, modulator, oscillator, or power supply circuit, the Handbook is the reference. Certainly it is not the only source for these standard circuits, but it is undoubtedly the least expensive. For $4.50, you get hundreds of circuits, dozens of construction projects, tube and transistor tables, chapters on setting up and operating a station, and a guide to reasonably modern building techniques. The Handbook is a long-term investment which will probably provide both the Novice and the oldtimer with a pretty complete reference library for general construction techniques, tube troubleshooting, and ham operating. It is unquestionably still CW, HF, and tube oriented; but it provides adequate, if not extensive, coverage of most ham techniques.

For those long-familiar with the Handbook, the 1971 version will not be any earthshaking break from the past but will show a healthy and immediately apparent infusion of solid-state circuitry and theory. The groups of construction projects in each chapter do rely heavily on transistors and diodes and even ICs. But the book does not ignore the experimenter with his huge tube junkbox. True, tube projects end up too big, too hot, too heavy. But to the fellow with the well-stocked junkbox, the disadvantages are worthwhile tradeoffs for expense. Tube projects can be cheap, cheap, cheap if you've a 10-, 20-, or 30-year accumulation of tubes, sockets, and junkbox parts.

There are all the familiar charts; and the transistor tables have been expanded although they are still lacking in breadth. A few of the old standby projects were deleted and a few new projects were added. If you buy new Handbooks as infrequently as I, this is the greatest bargain going at 50¢ a year. Even if you buy your Handbooks more frequently, it is still one of the few bargains around today. And for the radio beginner, it is an essential one-volume reference library.

WB2MYU■

A journalist tries for a scoop on La Balsa, and gets put . . .



ON THE SPOT

by Alan Shawsmith VK4SS

It was midday in Brisbane, Queensland, Australia. The place had gone plain crazy. The reason being that the *La Balsa* raft had at last been sighted. How such a primitive craft could have survived the many cyclones and reefs on an 8500-mile drift from Ecuador was past understanding.

My shack was a bedlam of noise and voices. The ham band receiver was turned well up on 13100 kHz where the VKs were concluding their assistance operation in cooperation with Emergency Air/Sea Rescue. From a broadcast set a local station repeated flash items on the raft's progress. The portable TV set was telling the viewers to stand by for scoop pictures. My telephone rang incessantly.

The door burst open and in rushed a buddy. "Hey, Al, I've got an assignment to cover the raft! It's fair dinkum. She's only a few miles off shore up the coast a bit."

I pointed to the TV where the first aerial shots were on the screen. Together we gazed in silent admiration and awe. There she was; a charcoal chip of a ship with a pocket hanky sail and bobbing pertly in a turquoise sea. From it four heavily bearded young men waved madly.

"Gosh," said my friend, Bob. "How'd they keep that tied together? I can't even make my kids' balsa planes stay put."

I turned down the receivers and we got to business. "Now listen, Al," he said. "You're gonna do a story on this, too, aren't yer? Well, let's combine – 'cause I need some help. You've all the knowhow to cover the ham angle and I've got all the gear for photos."

"Okay, it's a deal, but don't be too cocky about making the scene. Customs and quarantine officials are going to keep the raft anchored out in the harbor till they've done their routine on it. No one will get within shouting distance."

The lip of young Bob Harrow curled contemptuously and I remembered he'd been in strife with the Customs on more than one occasion. "That figures," he said.

"Just like their rotten form. It might take hours and while it's going on, some syndicated news medium will buy up the world rights and phut – that's it. The crew and the raft are in 'wraps.'"

"Well, regs are regs and – ."

"Yeah, but in this case they're red tape. What do the Customs johnnies think they're gonna find? Opium, by raft from Ecuador! – that's a laugh." Into the face of my young friend came a look I feared. Bob made each assignment a life-or-death challenge. We'd been out news-hunting before and the overenthusiasm he displayed at every obstacle quickly gave me a case of the shakes.

"Maybe it's best to wait till some of the hysteria and shouting has died down. Then we can have a look at the raft and – ."

The suggestion was brushed aside. "Al, you want pictures, don't ya? This means we gotta be on the spot, man. Right on the spot and organized, do yer hear? He made a gesture of impatience.

"The ETA happens to be around midnight. Not the best time to interview VIPs and take photos of the raft."

"It'll be a gas, man. I'll bring all my flash and color gear. You can have the tape recorder and we'll toss in my wet suit just in case."

"You mean – ."

"Yeah, I'll swim out to the raft if I have to."

" – and the gear."

"Let's worry over that problem if it arises."

* * *

We roared out of Brisbane on the 80-mile sprint up the coast to the usually sleepy small boat harbor of Mooloolaba. It was also the base from which ship pilots and customs and quarantine officers operated. "We've gotta find out just where they're gonna anchor that raft," Bob kept repeating. "We must be right on the spot or it's no go."

What a sight met our eyes. Never had this small village seen such a crowd. Like most uninformed mobs, they milled everywhere. The jetty, with its spindly legs, must surely collapse into the sea from the sheer weight of those struggling to get on it. There were TV camermen, announcers, technicians, reporters, journalists – the lot; you name it.

Bob leaped into instant action. "Al, you stay here and keep tabs on the gear and I'll mosey around and see what can be drummed up on the raft. It was two hours before he returned; I was getting anxious. There was alcohol on his breath and a gleam in the sharp eye. He held up two thumbs. "She's apples, Al – the good oil!. Struck a lad from the quarantine section at the local. Cost me a few beers but it was worth it." He pointed past the jetty across the mouth of the wide Mooloolaba River. "There," he said. "But I'm not aiming to wait till she ties up and Customs take over. As soon as she crosses the bar I'll board her myself."

"But that's a mile out."

"I've got my wet suit, snorkel, and goggles and now I'm off to find and hire a boat."

"How will you get past that?" I pointed to a searchlight being erected in the Customs enclosure.

Bob's lip curled again. "I'll see yer later. Oh, if yer need a drink, you'd better lock the car and make a dash for it, 'cause we're gonna have a pub with no beer soon. The news hounds are drinking it dry. There's another semitrailer load of the stuff on the way, but when it'll get here is another matter. He vanished into the crowd.

My mouth was dry but I resisted the temptation. Time enough for a quiet noggin when the action was over. Cars continued to stream in and small boats appeared from everywhere. More than once I heard a youthful shout. "Row you out to the raft for 40¢ a head, mister." The local kids weren't missing a trick.

This time it was dark when Bob returned and in a crestfallen mood. "Not a hope," he said miserably. "The 'scalpers' are in. They want a mint to row a yard. But I'm not licked yet, Al." There's a couple of boats in a little cove upstream. Let's take a look-see."

Very reluctantly I climbed into the car. Bob's impetuous determination might well lead us to disaster rather than a scoop.

Neither boat had oars and one was chained to a tree. The other was a tiny flat-bottomed plywood affair.

"Perfect," said Bob, eyeing the flimsy shell.

"For what?" I said sourly. "Both of us in that plus the gear and it'll sink. My bath back home is bigger."

"The tide's against us and as there's no oars, I'll swim behind and propel you with my flippers. Don't worry, she won't sink."

"Bob," I said pleading. "You know I'm a lousy sailor; as soon as we hit the open water I'll need a seatbelt and a paper bag." I cast a fearful look back through the trees to the house on whose property we were trespassing.

Reading my thoughts, Bob said, "Don't panic, we'll return the boat and no one will know."

"That's your view, but to the owner, it's thieving."

"Look" said my mate, getting impatient. "It's our last chance. Hop in and I'll get the gear."

"No, not in that bloody bit of bark."

We stood, both angry and in silent disagreement. Finally Bob said, "I'll go it alone." Quietly, he slipped into the water suit and prepared to cast off. At the last moment and without a further word I stepped into the oversized tub and we were away.

* * *

The trip to the raft's place of anticipated anchorage went off better than expected. We crept along close to the far bank where there was little current and darkness hid us from the glare of lights opposite.

"See, what'd I tell yer – a piece of cake," said my energetic cobber. He glanced at his watch and pointed in the direction of the distant murmuring surf. "See, there they come."

The tow boat approached and slid past and then *La Balsa*, with a lantern at the masthead, nosed gently and quietly into slack water. Instantly, a light from the bank was thrown on her and I could see movement in official quarters. We were alongside in a matter of seconds. There was a trace of surprise on the crew's bearded faces as Bob rose from the sea in his goggles and black wetsuit and leaped on board. All arms were instantly extended in handshakes. Congratulations, congratulations. Some photos, please, we requested. Capt. Alsar Vitalu (HC9EBP) was in the act of covering up the Hallicrafters SR150 with waterproof sheeting; he obliged by posing at the transceiver. In answer to my questions he said the equipment was okay except for the microphone; and the rig would load 110 watts into the vertical antenna. He wished to thank the VK hams for their vigilance and help. Bob was hurriedly adjusting his gear, clicking his cameras and cursing the moving searchlight for spoiling his shots.

A flotilla of small boats streamed out from the jetty and the fast Customs launch zoomed from its moorings. We pitched the tape recorder and gear into the little plywood dinghy I ducked into the reed-thatched cabin to congratulate again and thank the smiling, courageous captain and crew. It was then I spotted Minette, the ship's black and white cat. She crouched in a corner, terrified by the sudden strange intrusion and noise. I'm the world's greatest sucker, when it comes to animals. Stepping slowly forward, my arm went out to gently stroke and calm her. At the same instant, a hand fell on my shoulder and a voice demanded, "Who are you! No one's allowed on board until it has a clearance. I see you were fondling the cat and it has to be quarantined."

It was time to quit the scene. Bob had already left the raft. I made to follow but the Customs officer barred the way. "You'd better go aboard the launch," he said.

"But," I protested. "We're journalists and only came for pictures." Anxiously my eyes searched for Bob but the little boat had already slid into the darkness. The arm of authority remained pointing, so I did as requested. My cobber had insisted we be first on the spot. Now it seemed I really was *on the spot,* and likely to be quarantined along with Minette the cat.

The armada of small rowboats had reached the raft and confusion mounted. Propelled by the herd instinct, the pleas of

Bob tried hard for one good photo of La Balsa and her crew. This wasn't it, though. This excellent shot was snapped by the "Telegraph," a Brisbane newspaper.

the police to stay away from *La Balsa* went unheeded. People of all kinds clambered to get on board. There were shouts of welcome and congratulations. For a time it seemed the forces of law and order would lose the battle to keep the raft from being swamped. However, finally the tumult died. Customs completed their check and the launch returned to the quarantine station. The four trans-oceania adventurers were taken ashore to the local yacht club where an official reception, open to all, was to be held.

But not for me, alas. I was led to a large sparsely furnished room and handed a dressing gown, some six sizes too big.

"What's this," I said testily, "a tent?"

"Remove your clothes and put it on," said the officer.

"What for?" The distant sounds of repeated cheering and the singing of "For They Are Might Great Fellows" reminded me of what I was missing and pricked at my temper.

"It's the regulations for contanimated clothes – until the Doc clears you. But right now he's busy."

"Look," I said, trying the bluff that he who hollers loudest is often served first. I'm expected at that reception at the clubhouse. The Skipper of *La Balsa* is an amateur radio operator and there are other operators there waiting to extend an official welcome on behalf of our fraternity.

"Is that so?" He was completely untouched.

"Yes it *is* so, and I demand a clearance – now!" With a faint smile of contempt, he disappeared.

Realizing that further kicks at the Establishment would only result in a stubbed toe, I began to disrobe. A brusque but genial MD strode into the room.

"Oh, hullo there; sorry about the delay, old chap. No need to put you on a spot like this (the phrase was beginning to irritate) but precautions must be observed, you know. Just had a look at Minette myself. Cute cat. Love animals. Pity she has to be isolated. Well, now, no need to keep you." He pointed to a door across the hall. "Have a brushup in there before you go – cheers." He was gone.

* * *

The festivities were over when I reached the clubhouse. The early dawn light began to cast weak shadows. After a hero's welcome the four sailors had been whisked away and gone into smoke for a long overdue rest. I marveled at their tremendous physical condition and how they'd maintained it for so long in their primitive craft. Under a tree Bob's car was parked. He was nearly asleep and rather alcoholic.

"Sorry," I began.

"So you should be. Fancy getting trapped like that. I was about to come down and try and spring yer." He held up an unsteady hand. "Boy, what a night; I got some more photos and ran a bit more tape – if yer can hear it through the bedlam. He reached into the glovebox and produced a small hip-sized flask of brandy. "Your particular choice, huh!"

"How'd you manage – ?"

"Ssh. It's on the house."

"Bob," I said, "what would I do without you."

VK4SS■

Roger Ralston
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FM FM FM WALKIE TALKIE

Transceiver Directory

If you are seriously thinking about adding a walkie talkie (hand-held) transceiver to your 2 meter FM system, but confused by the many types of units and wide range of prices, I think this article will help you make your final decision. The advent of repeaters and the convenience of carrying around a small transmitter with a range of 50–100 miles makes the purchase of a walkie-talkie tempting indeed. Our company spent several months collecting information on all the VHF (high band) commercial two-way radio systems, including walkie-talkies, so that we could make the proper decision on purchasing the right equipment. Because we, like the amateur, were interested in getting the best value for our dollar, we tried to evaluate the tradeoffs of performance versus cost. Our research is summarized in the "High Band FM Walkie Talkie Comparison Chart" and the following paragraphs. The chart is arranged, from top to bottom, by retail cost (including the cost of a rechargeable nickel–cadmium battery). Information presented here is from manufacturer's literature and interviews with manufacturer's sales representatives. We hope the readers of 73 Magazine will benefit from our research.

VARITRONICS HT-2; Varitronics, Incorporated, 3835 N. 32nd St., Suite 6, Phoenix, Arizona 85018.

Originally marketed as the TELCO HANDICOM (see the performance review published in Volume 3, Number 6 of FM Magazine), this is a Japanese import reportedly exceeding the specifications shown on the chart. Already relatively low-priced, the HT-2 comes with crystals, nicad batteries, charger, earphone, carrying case.

JOHNSON MESSENGER 540; E. F. Johnson Company, Waseca, Minn. 56093.

This is probably the most inexpensive of the American-made walkie-talkies. A nice feature is a nicad battery that doesn't need a charger, just remove it from the bottom of the transceiver and plug it into any 110 volt ac outlet for about 1½ times the hours it has been used. With most chargers costing about $10 to $40, this is a good

savings and you don't have to lug a charger around with you.

SONAR 2301; Sonar Radio Corporation, 73 Wortman Ave., Brooklyn, New York 11207.

One of the few radios with a steel case, for rugged use. We hear that the component layout makes repair work easier, also.

UNIMETRICS MINIVOX III; Unimetrics, Inc., 39 Werman Court, Plainview, New York 11803.

Another Japanese import that looks very much like the Motorola HT 200. Aerotron also markets the same transceiver.

HALLICRAFTERS FM-1; Hallicrafters Co., 600 Hicks Road, Rolling Meadows, Illinois 60008.

Probably the most rugged of the lot. Its large size accommodates batteries that let it work for 40 hours with nicads, and even longer using standard D-size flashlight batteries (which are easy to buy anywhere). We've heard reports of the transceiver still working after such abuses as being run over by cars and rolling down hills.

MOTOROLA HT-100 (H13FFN); Motorola Communications and Electronics, Inc., 1301 E. Algonquin Road, Schaumburg, Illinois 60172.

The lightest transceiver of the lot, with easily a couple of hundred milliwatts of rf power output (though it's rated for 100 mW). Extremely sensitive receiver. It does a great job where a good repeater is within range. Very tiny (fits into the pocket). Expensive; also no mercury or alkaline battery replacement is available.

HALLICRAFTERS "HAND COMMAND" HC-100.

Made with lightweight solid aluminum case. Accessory jacks have waterproof covers. Many accessory options.

COMCO MODEL 802 (or COM-PAL II); Communications Company, 300 Greco Ave., Coral Gables, Florida 33134.

This walkie-talkie is probably manufactured for more companies than any other; the same transceiver is made for Aerotron (Model DPI5), RCA (Personalfone), and Radiomarine Corporation (see product review of page 30 of FM Magazine, Volume 3, Number 6). It is a completely waterproof walkie-talkie and its plug-in circuit modules make repair very easy. A 4W rf power output unit is also available.

MOTOROLA HT-220 (H23FFN and H33FFN).

The newest transceiver from Motorola and a true pocket unit. Three models are available: standard, remote, and universal. The standard unit does not have an external microphone and is about $100 cheaper than the price shown on the chart. The remote unit has an external microphone/speaker (no speaker in the unit itself), its price is the one shown on the chart. The universal unit has an external microphone, but a speaker in the unit. A 5W unit is also available. Note that you can have as much as 5 MHz frequency separation without degradation, important for repeater users. A special charger allows 100% charge in one hour! A rubber-covered coil-type antenna about 6 in. long makes out-of-pocket operation easier, but it's an accessory item.

BELL AND HOWELL KELCOM III; Bell and Howell Communications Company (Formerly Kel Corp.), 186 Third Ave., Waltham, Mass. 02154.

Another true pocket model, slightly smaller and lighter than the Motorola HT-220. It has a built-in compression circuit, which lets you talk while you keep the unit in your shirt pocket. A unique fold-over antenna enhances pocket operation.

GENERAL ELECTRIC MASTR PR36; General Electric Co., Mobile Radio Dept., Lynchburg, Virginia 24502.

This is GE's newest entry and the specifications look great. It has a voice-operated transmitter that allows true hands-free operation. Another good feature is a fast charger that provides a 70% charge in 15 minutes!

HIGH BAND FM WALKIE TALKIE COMPARISON CHART

MFR	BASIC PRICE ($)	RF OUT (W)	FREQ. ERROR (%)	SENS. (µV @ 20 dB)	SELEC. (dB @ 30 kHz)	INTER-MOD (dB)	AUDIO PWR (mW)	WT. INCL BATT (oz.)	SIZE, in. H	W	D	EXT. MIKE ?	TONE SQ AVAIL	MFR LOC
Varitronics HT-2 (2 freq)	269.95	1.6	0.002	0.4	−70		500	36	8.5	3	2	no	no	Japan
Johnson Messenger 540	425.00	1.5	0.001	0.5	70	60	750	28	8.5	3.5	2	yes	yes	USA
Sonar 2301	402.00	1.6	0.002	0.5	−85		250	42	8	3	1.5	yes	yes	Japan
Unimetrics Minivox III	439.45	1.8	0.0005	0.5	−80		400	40	9	3.5	2	yes	yes	Japan
Hallicrafters FM-1	521.80	1.5	0.0005	0.5	−60		150	70	11.5	3	3	no	yes	USA
Motorola HT 100	528.00	0.1	0.0015	0.35	−70	50	200	15½	4	3	1.5	no	yes	USA
Hallicrafters HC-100	529.00	2	0.0005	0.5	−75		500	45	9.5	3	?	yes	yes	USA
Comco Model 802	565.00	2.2	0.0005	0.5	−80		750	30	8	3.5	2	yes	yes	USA
Motorola HT 220	647.00	1.8	0.0015	0.35	−60	50	500	21	7	3	1	yes	yes	USA
Bell & Howell Kelcom III	660.00	1.7	0.0025	0.35	−60		250	18	7	2.5	1	yes	yes	USA
General Electric PR36	790.00	4.5	0.0005	0.35	−75	60	500	43	8	3.5	2	yes	yes	USA
Motorola HT 200	762.00	2.0	0.0005	0.5	−70	55	500	40	9.5	3.5	2	yes	yes	USA

MOTOROLA HT-200 (H23DEN).

The workhorse of the walkie-talkies. There are probably more of these units in use than any other. Good specifications, many accessory options, and two-frequency kits (and a four-frequency kit for amateur use) still make this transceiver desirable. As newer units are put into service, more used HT-200s become available. (Motorola sells reconditioned units to commercial customers; Spectronics, Inc., near Chicago, sells used Motorola units to amateurs.)

We hope our research and this short summary will help you choose the right walkie-talkie for your VHF amateur system. More details and data sheets can be obtained by writing the manufacturers listed in the preceding summary.

. . . Ralston ■

an ADVANCED Preamp-Compressor Clipper

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Oakville, Ontario, Canada

After a thorough literature survey on speech compressors, I built several of the more promising circuits and compared their performance. After this effort, all preferable features were combined in a single unit. The "unit" can take low- or high-impedance microphones with outputs from 0.1 mV up and delivers a husky 40 mV rms output with a total compression of 30 dB for a 4 dB output change. Output noise is −35 dB without signal and better than −35 dB with an audio signal, thus there is no noise "rush" when your voice ceases.

Experimental

I built five preamp-compressor units over the last few months; one is the "Caringella" compressor, one by DJ6BV (DL–QTC), one by W2EEY (73), one from "Electronik," and one of my own design. Four of them are somewhat complex and use four or more transistors; they use a variable-gain amplifier which produces its own agc for gain regulation. The other one is a clipper-type preamp–compressor which has a smaller compression range and more distortion, but has low noise characteristics. I used a scope and signal generator to measure compression, sensitivity, noise, and distortion. Attack and release times were calculated from R and C values in the line. On the Caringella compressor, I noted insufficient gain for low-Z dynamic mikes, which could be obtained by changing the FET input stage into an amplifier rather than an emitter follower. The unit distorted on low tones due to its fast attack time. Noise output was low, but frequency response was much too wide, particularly below 300 Hz, where an SSB crystal filter can't do anything for you. The compression is 30 dB all right, but there was a 6 dB output change versus 30 dB input change, which could have been an anomaly of the particular unit I had.

The compressors by DJ6BV and W2EEY are similar in design and yield roughly 25–30 dB compression for 6 dB output change. Both units lack sensitivity and are noisy in speech pauses. Attack and release times were adequate and no noticeable distortion occurred. The unit from Electronik was specified at 40 dB compression, but I judged it to be a rather odd circuitry since gain control is achieved by resistive shunting in various amplifier stages; therefore, too many transistors were required. Also, the sensitivity was not adequate and, in order to change the frequency response, some component changes were necessary. The last unit, one of my early designs, is a two-transistor preamp with a clipper at the output. Though the output noise is very low, the compression range is 20 dB at the most for reasonably low distortion. This unit is very

small and can easily be fit into a transceiver. The power can be derived from B+ since it runs with 20–25V at 1.6 mA only.

Circuit Design

It was obvious that the "perfect" compressor had to combine all good features, among which are:

- Adequate compression range (25 dB minimum).
- Sufficient gain for all types of microphones.
- Low-noise output, regardless of gain state.
- Fairly low attack time, medium release time, and low distortion.
- Selective frequency response (preferred range 300–3000 Hz).

The first parameter seemed easy to meet. I chose the DJ6BV/W2EEY way since it was simple and very effective. I obtained a negative signal to change the conductivity of a silicon diode (D1). This permits ac bypassing at the emitter of an early amplifier stage. I chose an attack time of 100 ms, slow enough not to regulate on the sine wave slope of a 300 Hz sine wave. Adequate gain is available through the use of a field-effect transistor preamplifier stage. This FET runs with moderate gain and improves the signal-to-noise ratio considerably. A 0.1 mV (rms) input signal will yield full agc voltage if the volume is turned up fully.

At the output of the compressor, however, there is a 20 mV (p-p) of noise. This noise is reduced to about 0.5 mV after it passes the following clipper stage. The clipper will also cut excessive peaks which occur within the 100 ms of attack time of the compressor, and will improve the 6 dB constant output to 4 dB for 30 dB compression. The compressor has a bandwidth of 300 Hz to 100 kHz (−6 dB). After the clipper, however, the upper response drops off sharply above 10 kHz. You need not worry about the 3–10 kHz range; your crystal filter will not pass more than 3 kHz anyway.

Adjustments

I did all my adjustments and measurements with a Tektronics' scope. Using the mike, I could see how constant the output level was when I talked right into it or at a distance of a couple of feet. For a steady signal source, I used a signal generator which permitted me to check on distortion. An easier way of adjusting the unit is to use a tape recorder with recording meter or "magic eye."

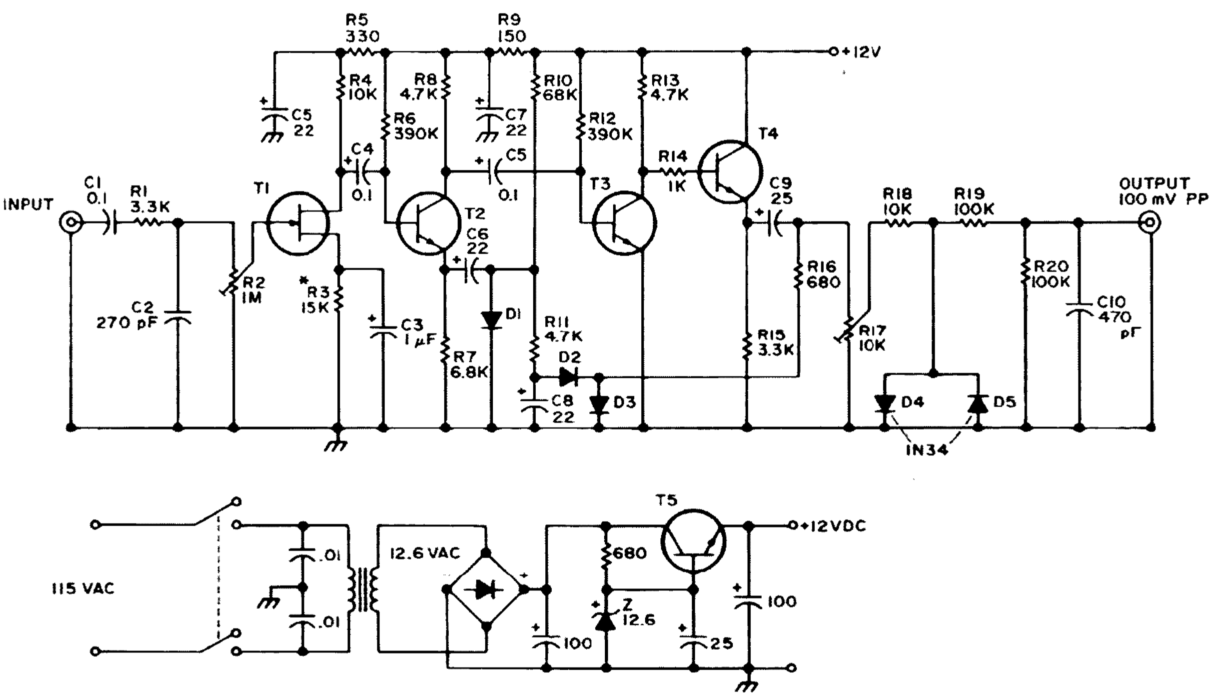

Fig. 1. Compressor schematic.

Power Supply

The unit requires 10–15V at 5–8 mA with low ripple. A battery can be used, but I preferred a simple regulated supply that operates from the 115V line.

The Speech Simulator

There are various ways of tuning the final stage of a transmitter or kW linear. For SSB, however, most hams take a deep breath and howl a long "aaah," trying to keep the loudness as steady as possible. Wave tones are rarely used since they cause about 4–5 times the plate dissipation on the final tubes than an "aaah." Most finals just don't take that for long. The speech simulator consists of a multivibrator which produces a 500 Hz square wave.

The square wave is integrated after it passes an emitter follower. The oscilloscope pattern of the derived signal is similar to that of an "aaah," and so is the power distribution. Since square waves are rich in harmonics, the latter are integrated also and such harmonic spikes are present up to a few thousand hertz. The generated tone is unique; it sounds somewhat like a ship's siren in heavy fog.

Occasionally, I use the tone to break in on roundtable QSOs when my voice doesn't do the trick. With this signal, you can run your final wide open without fear that you'll blow your tubes. The signal is also handy for antenna tuning – your own, or supplying someone else with a steady audible signal.

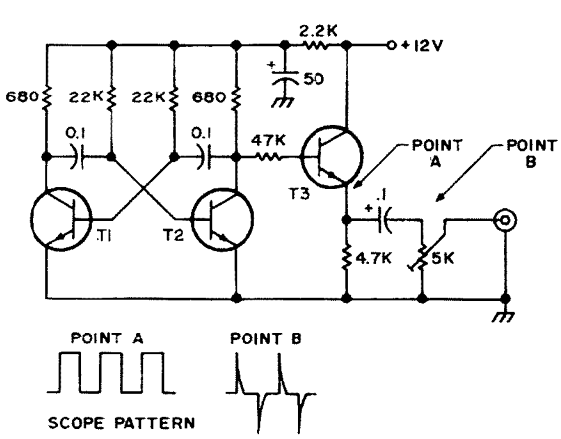

Fig. 2. Speech simulator schematic.

Conclusions

The compressor unit performs very well. I hooked it up to a tape recorder to check performance and quality of the audio. I could speak loud or gently, close or several feet away from the mike and still got the same volume out, audible or on the dB scale. The voice sounded clear, fairly light and of monotone quality. On the air, I demonstrated the unit to several hams. My set up enables me to switch from straight voice to a diode clipper and to the new compressor–clipper. A drastic difference in voice readability was reported, particularly when the signal was decreased to an S2 level on the partner's receiver. As to the cost: there are $18 worth of parts, plus a cabinet. An optional "speech simulator" tone generator cost me $5. The two units make a nice combined project which I rate worth the expense.

. . .VE3GSP

THE TRANSISTORIZED LM FREQ METER

A few simple modifications and you can plug FETS right into the tube sockets.

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The last word may never be written about the BC-221 and LM frequency meters. The LM is particularly attractive because it is in the smaller package. With transistors replacing tubes, it has features most everyone wants – it is rugged, portable, and accurate, to name a few. I will describe a conversion of an LM-15 frequency meter in which field-effect transistors replace tubes; the power supply becomes a standard 9V transistor radio battery and the current drain is less than 3 mA when all functions are energized. In addition, I offer calibration information which will be of interest to anyone having a BC-221 or LM without the official calibration book. I bought an LM-15 for a temptingly low price (Fair Radio Sales Co., Lima, Ohio, $14.95). The set is sold in the "as is" condition with tubes and crystal but without calibration book. It is a good idea, but not necessary, to start with a set which is working before making the change to FETs. Resistance measurements will show if the circuits are complete. Important values are marked on the schematic of Fig. 1.

Smash Tubes

The most difficult part of my conversion was getting up the courage to smash the tubes! I wanted the bases for mounting transistors. Place the tubes one at a time in a paper sack, hold the top closed and with a metal object, strike the glass through the paper. The flying glass is caught and collected for disposal. Scrape and clean the mastic from the inside of the tube bases. Should you choose to mount a transistor socket in the wall of each tube socket, you can use the original wires; otherwise, unsolder the old wires and replace the needed ones with about 2 in. of sturdy new tinned wires. The appropriate tube base pin connections are shown in Fig. 2. Actually there is no preferred mounting scheme. Use whatever appeals to you.

Check for clearance between socket and walls. My conversion used transistor sockets mounted on metal plates which were bolted to the wall of the salvaged tube bases. This allowed FET substitution to determine which ones would work best in the several circuits of the LM. All FETs used are N-channel.

Modification

With cover removed and the LM in the upright position, front panel toward you, on the left side wall, look through two oblong machined slots and see mounted on a phenolic board a 50 kΩ plate resistor. Parallel it with about 6 kΩ. Turn the LM upside down, panel toward you. On the underside, two resistors must be shorted and a jumper wire made up and connected. Short R115, which is a 15 kΩ wirewound resistor, quite visible on a phenolic board at the left of the 1000 kHz crystal can.

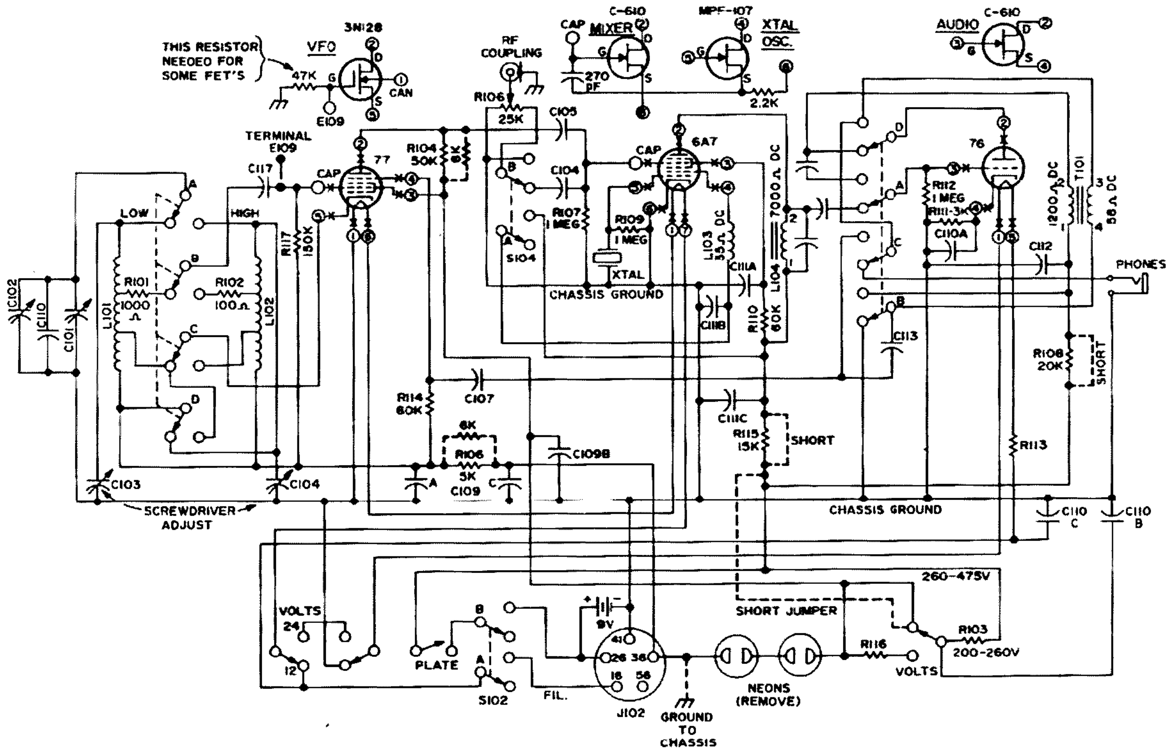


Fig. 1. Modified schematic of frequency meter.

Run an insulated wire from a terminal of this shorted resistor to the 260–470V tap contact of the link switch. This wire can be about 6 in. long and conveniently passes through a wall slot behind the crystal socket. The link switch and its terminals are on a phenolic board in the compartment aft of the crystal socket. The jumper wire will cross near the grid resistor, R109, of the crystal oscillator. While there, change the 100 kΩ (R109) to 1 MΩ. Next, unfasten the screws holding the phenolic board located to the left of the power plug. Tip up the board and short across R108. This is a 20 kΩ composition resistor which is in the plate voltage line to the audio amplifier. Also, at the power plug, locate pin 36. Short it to chassis ground. On most sets pin 36 is the ground return for the vfo cathode. The circuit was closed through external connections in a power supply. You have completed the surprisingly few changes needed to make the LM work on FETs and a 9V battery.

The VFO

With FET source connected to pin 5, drain to pin 2, can to pin 1 (if needed), plug the FET into the vfo socket. Connect a solid wire between terminal E109 and the gate of the FET. (Terminal E109 held the grid cap wire for the vfo tube.) Connect a 9V battery to the power plug pins. PLUS to 26 and MINUS to terminal 41. If you have a milliammeter in the battery lead, it should read about 1.5 mA when you turn on the FIL and PLATE switches. Provided you were fortunate in the choice of FET, you should hear a clear CW signal in your receiver. Set your receiver to 2 MHz or 4 MHz. You may need to connect a wire from the rf coupling post on the front of the LM to your receiver antenna. Rotate the LM dial between 0300 and 0600 on the readout. Your vfo will be on the low end of 125–250 kHz or 2–4 MHz depending on the position of the low or high band switch. The XTAL and MOD switches should be off. The FET selected for the vfo may require a 47 kΩ resistor between gate and chassis ground. I found this to be true for the RCA 3N128, 3N142,and *one* of the two 40559A FETs. On the other hand, one RCA 40559A and one of several 2N3085 silicon N-channel FET from Poly-Paks worked beautifully without adding 47 kΩ to the gate.

Apparently junction and insulated-gate field-effect transistors have slightly different characteristics which show up in this peculiar vfo circuit. My own choice is the 3N128 with the additional resistor on the

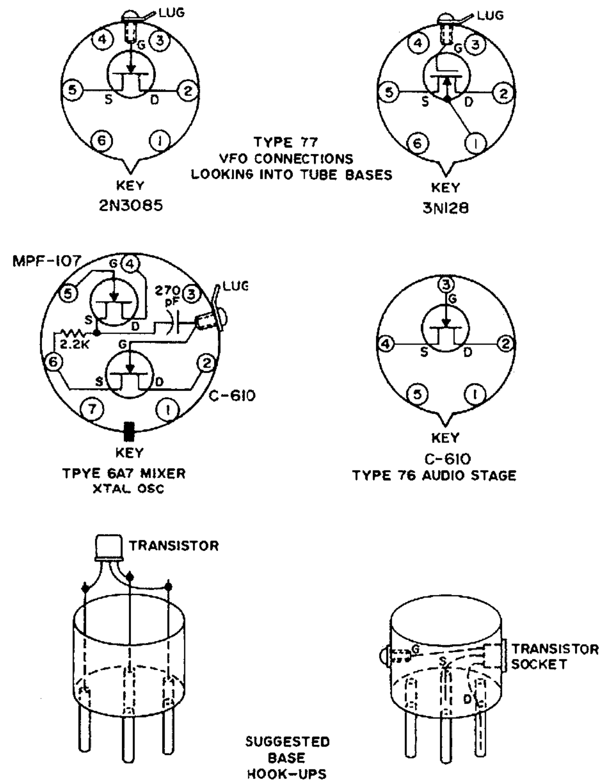


Fig. 2. Suggested semiconductor hookups for tube sockets.

gate. You may find it necessary to "tune" the source, drain, and gate resistances in order to have your vfo working well with a particular FET. I used potentiometers across the various elements to arrive at the recommended values. My vfo works reliably from 10V down to 6V and the maximum drain current is 1.5 mA.

Caution

Other oscillator hook-ups may occur to you, and they will work – but the tuning range and linearity of the vfo will suffer! Linear tuning is most important, so stick with that shown.

The AFO and AF Amplifier

The audio oscillator and amplifier wasn't as fussy as the vfo. I used a Radio Shack 276-664 FET – it is said to replace a C-610 or 2N3088. I found that the Poly-Paks "hobby" FET 92CU588 will work equally well. In making up the socket, gate goes to tube pin 3, source to cathode pin 4, and drain to plate pin 2. That is all there is to this one. Plug in the FET. When you next turn on the 9V power, the milliammeter will barely increase a few hundred microamps as you switch on the modula-

tion control. At this moment a rather pleasant 500 Hz tone will appear on the vfo frequency no matter which harmonic you have tuned in on receiver. Your modulator is finished. The audio amplifier is too, for that matter. You just won't hear anything in the headphones untill you complete the crystal oscillator and the mixer circuits.

Crystal Oscillator

The reference oscillator is not much trouble. You have already changed the gate resistor from 100 kΩ to 1 MΩ. Actually this change may not be necessary because some crystals are more active and will oscillate well with the original resistor. Mine went into oscillation better with the higher value. The FET you select for this circuit can be one of several. Mine is a Motorola MPF-107. I found the Radio Shack 276-112 and the Poly-Paks 2N3085 also work, but draw more current. Whichever you choose, the gate connects to base grid pin 5, source to cathode pin 6 *through* a 2.2 kΩ resistor. Drain hooks to plate pin 4.

Now, when 9V is turned on, MOD off, XTAL on, you should hear the crystal oscillator signal every 1000 kHz on your receiver. The milliammeter should increase about 1.5 mA or less when XTAL is turned on. If you don't hear the crystal frequency, bring the receiver antenna wire close to the crystal FET. We still haven't made the connection which adds the crystal-oscillator signal to the rf coupling post on the front of the LM. Assuming you have all circuits in working order up to this point, we move to the mixer.

Mixer

There is no single FET substitute for a pentagrid converter tube. The dual-gate MOSFET comes closest; however, use of one would have defeated my goal of simplest conversion. Therefore, four N-channel FETs are needed to do the work of three tubes, but what a saving in power supply! The mixer concerns itself only with beat frequencies occurring between the reference oscillator, vfo, or an external signal – all audio work. Thus, a hobby

FET was selected. I used the Poly-Paks N-channel FET. A Radio Shack C-610 replacement will also work. Connect source to chassis ground through pin 6 of the tube socket; the drain connects to plate pin 2, gate to mixer grid cap wire through the lug in tube socket wall.

Finally, connect a capacitor (200–300 pF) from the top of the 2.2 kΩ crystal oscillator source resistor to the gate of the mixer FET (grid cap wire). You are in business.

With 600Ω phones plugged into the LM, you should hear all the necessary beat frequencies occurring between the vfo and the crystal oscillator as you tune the vfo through its range. XTAL must be on and the MOD switch off. Otherwise, the audio amplifier becomes the modulator and you hear nothing in the LM phones.

What Next?

With the beat notes loud and clear you are ready to calibrate. This is quite the most fun part of the work because the linear tuning rate of the LM is almost unbelievable. The slow rate is due to the series combination of the A section of C109, C101, tuning L101 or L102. The amount of the matter is that one revolution of the 100-division circular dial produces about 3 kHz change on 125–250 kHz range, and about 50 kHz per revolution on the 2–4 MHz range. The actual calibration of my unit was 2.89 kHz and 45.17 kHz per revolution.

The linearity can be checked by how little you need to vary the "corrector" for each zero-beat checkpoint. Each LM or BC-221 will be slightly different. Now, when you consider that the vernier allows you to split one division into tenths, then it is clear that you can set a frequency to better than 0.5 kHz over the range of the frequency meter. May I repeat:

1 dial revolution of
100 div = 45.17 kHz
1 division = 0.4517 kHz
1/10 div = 45 Hz

Therefore, all you need is a checkpoint at which to zero the vfo and start counting revolutions, divisions and tenths of divisions to accurately set any frequency within the two ranges of the vfo. I found it useful to construct graphs on K&E 358 11L graph paper. The grid is 10 X 10 (per 0.5 in.). The paper has 20 units vertical and 30 horizontal. This allows graphing 100 division and leaves room for 10 vernier divisions on the right hand end of the paper. Use the crystal checkpoints listed in Table I to locate *your* dial settings. Once graphed, a frequency can be selected directly from the chart, or, depending on the accuracy desired, interpolated between checkpoints.

Table I. Crystal Checkpoints

KHz	VFO	XTAL	Approximate Dial Settings
Low Band			
125	8	1	0320
150	20	3	1192
166.667	6	1	1750
200	5	1	2935
222.222	9	2	3700
250	4	1	4647
High Band			
2000	1	2	0396
2250	4	9	0945
2500	2	5	1493
2750	4	11	1050
3000	1	3	2606
3250	4	13	3150
3500	2	7	3711
3750	4	15	4262
4000	1	4	4812

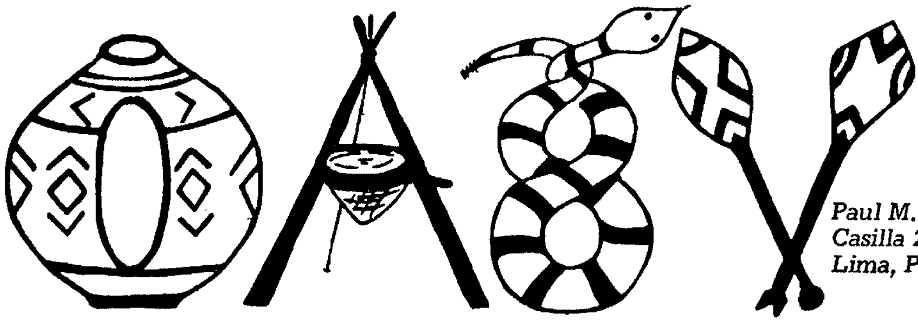
It is obvious from this discussion that the low band of the LM is fabulous. You can squeeze down to about 3 Hz by use of the vernier scale. By the way, hidden behind two cover plates just beneath the corrector knob, are "high" and "low" padder capacitors. These were used when vfo tubes were replaced to bring calibration book values into usefulness. The padders should be set near the middle of their range.

Make it Handy!

Fasten a handle to the case, strap on a 9V battery, go forth and have fun with your rejuvenated frequency meter. I use mine for its intended purposes as well as a band-edge marker and keying monitor.

W5SOT■

HAM RADIO, the BIBLE, and PERU



Paul M. Wyse OA8V
Casilla 2492
Lima, Peru S. A.

The following message was on the printer when I walked into the shack:

OA8G DE WA4ZRS
NR 662 WAXHAW, N.C.1230Z 22 SEPT. 1967
TO NORMA FAUST, YARINACOCHA, PERU
FROM VICTOR FAUST, WINDOM, MINN.
FATHER PASSED AWAY VERY SUDDENLY LAST NIGHT. CAN YOU COME HOME?
LOVE,
VIC

Bible translator Norma Faust was in Naranjal, an isolated Amazonian Cocama Indian village about 250 miles north of Pucallpa, and there was no connecting road. Norma and her partner, Lucy Eakin, were there teaching Indians to read their own language which had only recently been reduced to writing. Would Norma be able to return home in time for her Dad's funeral? Thanks to amateur radio, there was a good chance she would.

Soon after the RTTY message was received, missionary pilot, Floyd Lyon (OA8AT) was flying one of our airplanes across the vast jungles to bring Norma in to our jungle base, Yarinacocha, where plane connections could be made to Lima and then on to Minnesota.

Norma, Lucy, and over 2000 colleagues make up a team of workers specializing in the task of analyzing unwritten languages, reducing them to writing and then translating the Bible for the speaker and reader of these languages. This team, known as the Wycliffe Bible Translators Inc., is presently working in isolated areas of 21 different countries. Radio communications are relied on heavily for the health and safety of the workers. Linguistic investigation and Bible translation in over 450 distinct languages and dialects is being carried on and with the help of many electronic devices, goals are being set to complete during this century the remaining 2000 languages still in unwritten form.

Of course, not all of us on the team are in actual linguistic and translation work. I am a radio operator and spend much of my time operating a net of some 20 battery-powered SSB transceivers, which our linguists use in the isolated Indian villages. I find the operation of this net, which meets on the assigned frequency of 5340 kHz, to be very challenging and rewarding. For our linguists it is a vital link with civilization.

Many times the linguists out in the tribe request phone patches with our base doctor to seek advice on the treatment of snakebite or a bad cut. There have been times too, when radio has saved the life of a member of the translator's family, such as when a child got into a bottle of aspirins or when another inhaled a near lethal dose of kerosene.

Radio not only provides needed communications to remote jungle villages, but it also is the lifeline for our pilots as they fly thousands of hours over the jungle, much of which is still uncharted.

Jungle Aviation and Radio Service, known as JAARS, is the technical service arm of the Bible Translators. Communication service is provided to many of the remote and uncivilized Indian villages with an international network of over 150 battery-operated transceivers. Among the

more than 75 highly trained personnel of JAARS serving as radio technologists, radio operators, aircraft pilots, and mechanics, there are at least 32 radio amateurs signing such relatively rare prefixes as CP8, HC7, OA8, HK3, and VK9.

Bill Sasnett (WØTEM/4) is the director of the radio department at our JAARS Headquarters near Waxhaw, N. C. Here Bill directs a three-month concentrated training and orientation course for all new radio members to better prepare them for their work in the remote areas of the world. In addition to the three months spent in training at the JAARS center, each trainee takes three months of jungle survival training in Mexico.

At the JAARS center one also finds amateur radio playing an important part in the operations. The WBT club station, WA4ZRS, is used by the licensed hams working or training in Waxhaw. WA4ZRS is, likewise, net control on a daily traffic net operating on 21.360 MHz between 1400Z and 1500Z to handle traffic with the different countries where third-party

Omer (OA8G) checks the RTTY printout for news from the mainland. Ham gear keeps the Bible translators in effective contact with the outside world.

Yarinacocha is one of those jungle outposts where overgrowth is too thick for a landing field. This PBY will settle for a stretch of placid water, though. Pilot is OA8AQ.

traffic is permissable. The 15 meter net is useful in keeping contact with our different fields, and also serves as a practical means of training new members which will be useful to them on the field.

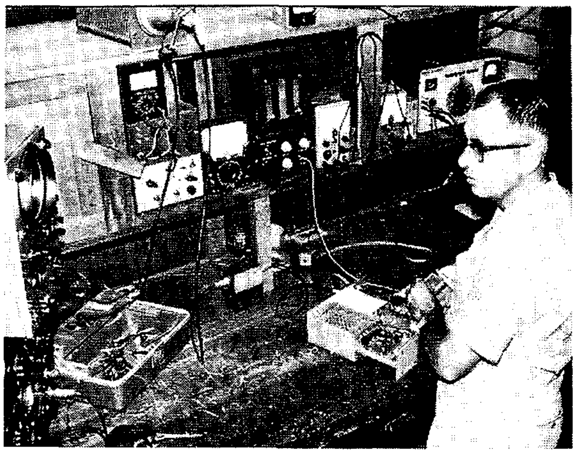
Since obtaining my first license (K4ASM) over 14 years ago, I have found many hours of pleasure and recreation in amateur radio. In addition to being a hobby, amateur radio also provides a real service, especially when one is isolated such as we are here at Yarinacocha.

I would like to express my appreciation to WB4IFK at the DUKE Medical Center in Durham, N. C., who maintains a faithful standby on 20 meter SSB and 15 meter RTTY to patch doctors throughout South America to medical experts providing unavailable counsel on medical problems in the jungles. This is a real service to all our health needs.

Amateur radio has also proved to be a big asset to us technically. Vic Poor (K3NIO) helped round up some surplus equipment and encouraged the use of amateur RTTY between WA4ZRS and OA8G. We have had very good success with an autostart RTTY link which is crystal-controlled on 21.100 MHz. This circuit has proved to be a real timesaver in handling much of the routine traffic for the 200 translators here in Peru. We have found 15 meters very reliable in providing communications to the eastern states during most of the daylight hours of the year. We hope that more of the South American fields will soon be able to join us on RTTY. I try

to take a standby for breakers whenever I finish with the traffic at various times during the day. I have very little time to spend on RTTY outside of schedules but am interested in giving as many as possible an RTTY contact from the jungles.

In the past, the task of analyzing an unwritten language, reducing it to writing, and translating the New Testament has taken 20 years or more. The use and

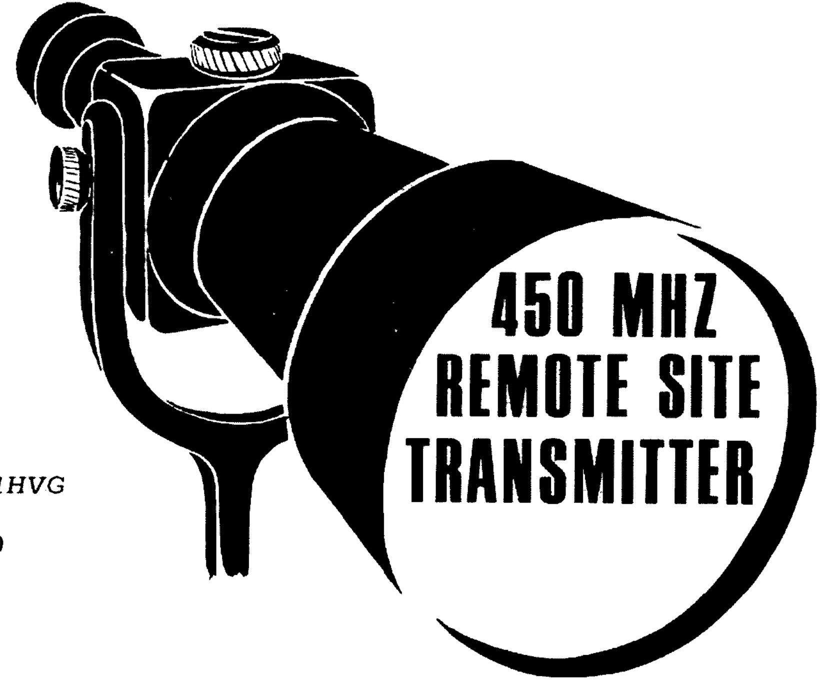


Paul (OA8V) tunes up one of the Pioneer 425 transistorized transceivers on 5340 kHz.

provision of radio and aviation has reduced this time considerably. Now Joe Grimes (XE1JJ) is experimenting with the use of Teletype, computers, and automatic typesetting equipment which could easily reduce the whole process to less than ten years.

As our linguistic and Bible translation work utilizes more of the advances in electronics, more technical missionaries will be needed to enable us to reach our goal of reducing the more than 2000 languages to writing. Besides radio technicians (minimum requirement: first class phone and general class ham ticket), pilots, printers, typists, schoolteachers, mechanics, and other specialized skills are being sought. As more countries make agreements for reciprocal licensing and third-party traffic, amateur radio will become more and more useful, not only for the safety and service but for the encouragement and technical help our hobby affords. A big thanks to ham radio, where fun and service have been combined for the world-wide benefit of many.

. . . OA8V ■



450 MHZ REMOTE SITE TRANSMITTER

Wilfred Collier WA1HVG
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Peabody MA 01960

Many of the repeaters now being built are using 450 MHz for control or auxiliary inputs. Unfortunately, most of the gear available for use on 450 is either antiquated or expensive.

Both Motorola and GE use tubes in the power amplifier stages of these transmitters – tubes that cost many dollars each, and need replacement about once a year – or even more frequently, depending on use and power output. As this article will show, however, solid-state rf amplification just isn't all that hard to come by – simply "do it yourself."

The 450 band is looking more and more attractive for ordinary repeater operation nowadays, anyway – particularly in view of the heavy crowding in the 2 meter spectrum. Probably if more people were aware of the good coverage achievable on UHF, there would be a stampede for the 450 band by those closed repeater groups so active on VHF.

Path Loss

One factor that adds up quickly in the UHF spectrum is path loss. On 450 MHz, the ability to use a repeater 40 miles away just may be governed by how many trees your signal must pass through to

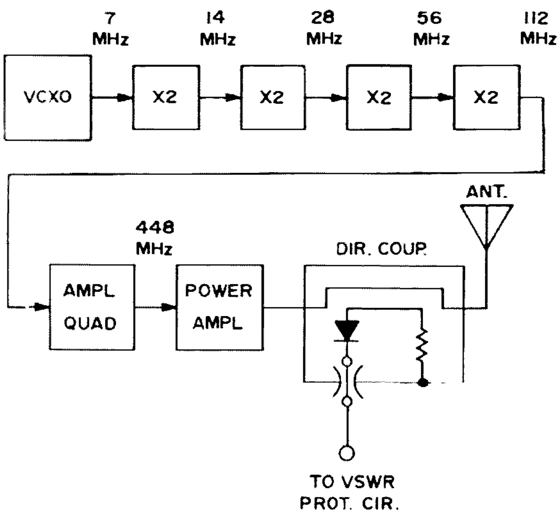


Fig. 1. Block diagram of 450 MHz transmitter.

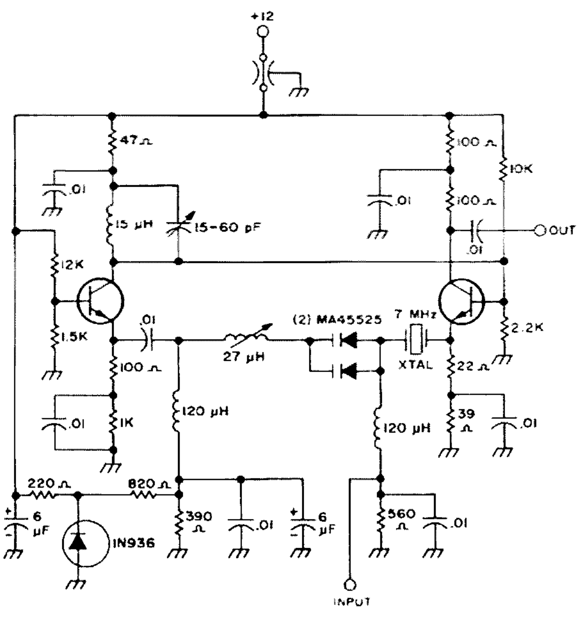


Fig. 2. Variable crystal-controlled oscillator circuit.

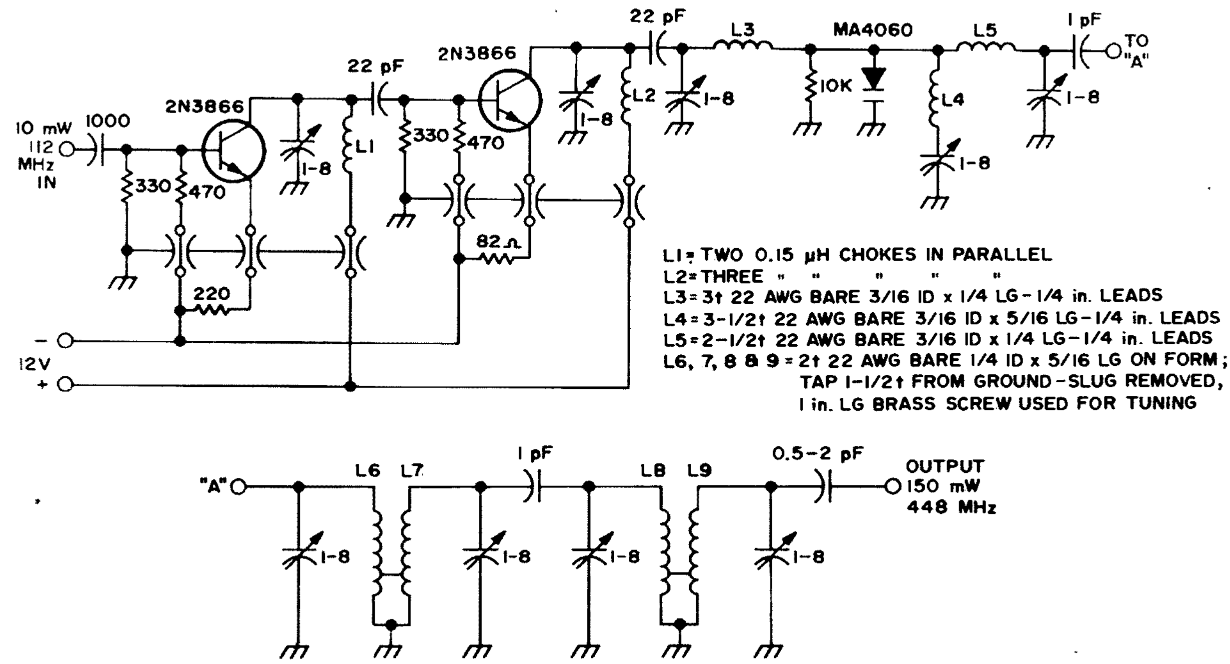
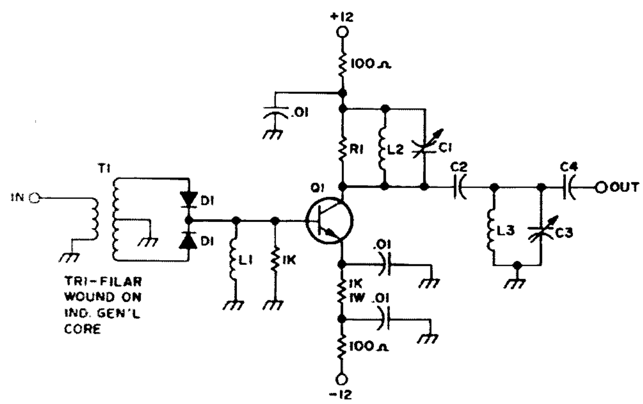


Fig. 4. Multiplier stages of transmitter. A 10 mW input signal is quadrupled to 448 MHz, at a power level of 150 mW.

reach the repeater site. The path loss on 450 is not greatly higher than that of the 2 meter band over average terrain for a given distance. To maintain a 99% reliability factor, the system must be set up for a 30+ dB fade margin.

Example: If the 450 receiver has a –115 dBm (0.4 µV) sensitivity for 20 dB of quieting and the transmitter is 40 miles away running 10W output (neglecting feedline losses and antenna gains, which



INPUT FREQ	T1 *	D1	L1	L2	R1	C1	C2	L3	C3	C4	Q1
7 MHz	61-01 CORE	1N914	150 µH	15 µH	2.0K	33 pF FIXED	3 pF	6.8 µH	5-18	5 pF	2N3904
14 MHz	61-02 CORE	HP2800	47 µH	2.2 µH	2.2K	10 pF FIXED	3 pF	1.8 µH	5-18	5 pF	2N3904
28 MHz	61-03 CORE	HP2600	6.8 µH	0.47 µH	OMIT	8-25	1 pF	1.0 µH	2-8	3 pF	MPS918
56 MHz	61-03 CORE	HP2800	3.3 µH	0.33 µH	OMIT	2-8	1 pF	0.15 µH	5-18	3 pF	MPS918

* INDIANA GENERAL CORE MATERIALS SHOWN

Fig. 3. Basic doubler block.

ultimately must be added in), the fade margin is;

10W	= +40 dBm
rec. sens.	= –115 dBm
difference	= 155 dB
path loss	= 160 dB
difference	= 155 dB
fade margin	= –5 dB

In other words you may *just* be able to use the system, but only occasionally will your signal be full quieting; most of the time you will be noisy into the 450 receiver.

Now let's look at an accurate case.

5W out	= +37 dB
feedline loss	= 3 dB
ant. gain	= 17 dB
total	= +51 dBm = 125W radiated power
Rx sens/20 dB	= –115 dBm
feedline loss	= 3 dB
antenna gain	= 17 dB
total sens	= –129 dBm

Fade margin = 51 + (–129) = 180 – 160 = 20 dB margin.

This means that 99% of the time your signal will be full quieting at the 450 receiver. I have purposely ignored antenna height gain, as this will vary considerably and is covered comprehensively elsewhere.

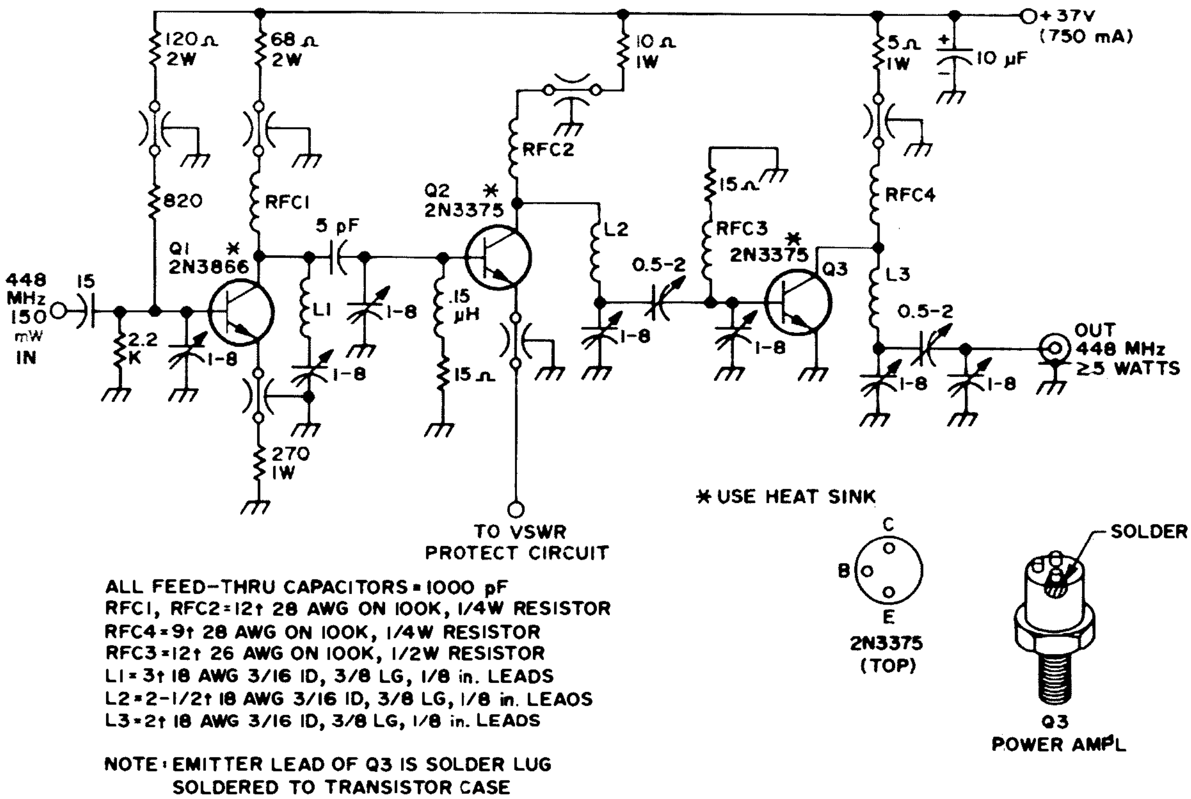


Fig. 5. Rf power amplifier stages. With a 150 mW input, a signal of at least 5W is produced.

Transmitter

As shown in the block diagram of Fig. 1, the design of this transmitter is straightforward; and it is easy to build and tune. Deviations from values upwards of 10% will not affect the operation; however, I do recommend that no changes be made in the type of transistors or diodes.

The oscillator (Fig. 2) uses a 2N3866 and a 2N3904 in an emitter-feedback configuration. The inductor in series with the crystal is used to match the output signal to the system receiver. The crystal should be ordered to operate in the "series resonance" mode. The oscillator puts out 10 mW. If the 390Ω resistor is changed to 270Ω this unit will drive a Gonset or any other small communicator.

The multipliers (Fig. 3) are push-push doublers, and need be tuned only for maximum output. Spurious responses measured better than 37 dB down from the signal in all cases when the multipliers were tuned for maximum output. Each stage is designed for a gain of unity so that the 10 mW power level is maintained throughout.

The power-amplifier quadrupler stage (Fig. 4) consists of two 2N3866s as amplifiers, a varactor multiplier, and a bandpass filter. The output of this stage is

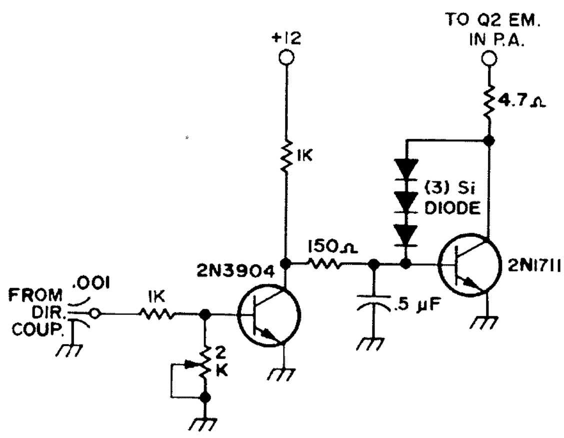


Fig. 6. Vswr protect circuit.

at the 100 mW level, and can be monitored on an FM receiver.

The final amplifier (Fig. 5) uses a 2N3866 and a pair of 2N3375s to achieve 5W output. A vswr protect circuit (Fig. 6) is included to add to the life of the output stage. The unit will not be damaged if the antenna is accidentally open or short-circuited.

Layout

All leads in both the quadrupler and the power amplifier must be *short.* I cannot stress this point enough. A ½ in. piece of 20-gage wire makes a reasonable choke at this frequency!

All of the transistors in these stages *must* have good heatsinks. I first built the unit on an aluminum box, and bolted a heatsink to the outside. Second thoughts were generated when I found out how hot things got after 30 minutes of operation. I suggest that the power amplifier be a separate unit built directly on a heatsink and not in a box.

Tuneup

Apply power to the oscillator only and check the frequency with a good stable receiver. The note produced with the bfo on should be pure and stable.

Apply power to each succeeding stage, tuning each for maximum power output. Output frequency should be checked after each stage is tuned. Each stage should be checked for stability after it has been tuned by removing the crystal from the oscillator. All output should disappear in all stages. If by chance it does not, isolate the problem stage and decrease the value of the collector resistance until it becomes stable.

The power amplifier should be tuned with only 20V applied at first. Tuning in these stages is affected by both supply voltage and drive level; 2–3W output should be seen with a 20V supply and 100 mW drive.

Directional couplers are covered reasonably well in the VHF manual. The only really critical part of the coupler is that it have sufficient directivity, or the transmitter will shut off. The coupler can be checked by using a 450 source such as a signal generator and a good load. Reversing the coupler should make an order of magnitude change in the voltage as shown in the diagram of Fig. 7.

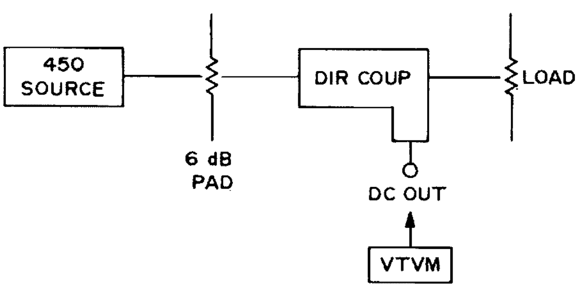


Fig. 7. Reversing the coupler should make an order of magnitude change in the voltage.

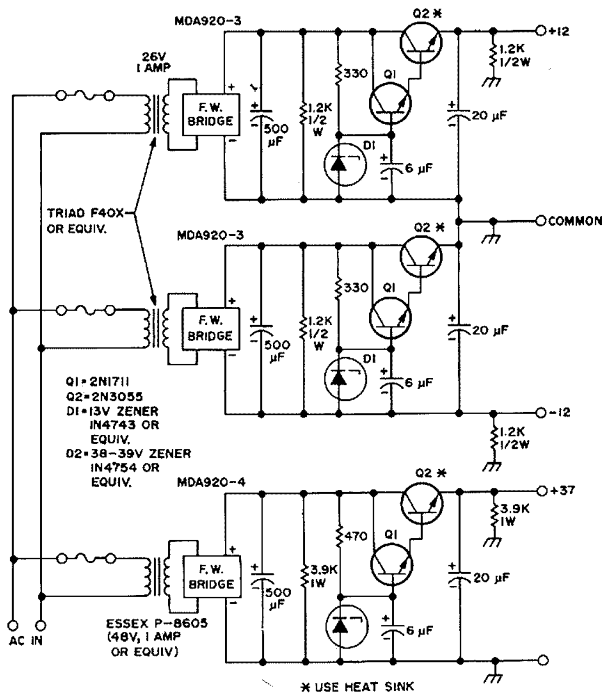


Fig. 8. Solid state power supply for 450 MHz transmitter.

Loads

If you don't have a good load for 450, then use 100 ft of RG-58/U and terminate it with a 2W 51Ω carbon resistor. This load will handle up to 60W input at 450 MHz! (There is a hidden clue about the line loss here.)

If built as described, this transmitter will maintain 5W output (continuous operation) for a long, long time. It should outlast any tube-type transmitter by a wide margin.

In the interest of completeness, I have included a power supply schematic (Fig. 8). This supply has proved quite adequate for the 450 transmitter, but it does require effective heatsinking.

I would like to thank Donald Sicard, Curt Seaton, George Meyer, and Norvill Staplefeld for their able-bodied assistance and incentive.

. . .WA1HVG■

THE S DERIVED FILTER

Allan S. Joffe W3KBM
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Philadelphia PA 19119

If you are familiar with filter nomenclature you have come across the constant-k and the m derived, etc., but my favorite type filter, the "S" derived type really belongs to the ham. This is because "S" stands for surplus. The general truth is that many potential goodies are bottled up within black or gray cans gathering dust at your friendly local surplus house. The problem is how to operate on your potential treasure after you decide it has merit as the base for an "S" derived filter. In an attempt to light one little candle in the wilderness I will describe the events leading from discovery to successful utilization of the "S" derived whatzit.

A recent field trip to Fertik Electronics at 9th and Tioga here in Philadelphia turned up a typical low priced, gray boxed goodie. The markings indicated that it was a tuned circuit 288.0 Hz type manufactured by Raytheon. The diagram on the box showed a centertapped inductor with a shunt capacitor.

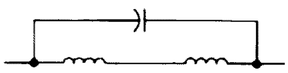

Fig. 1. Original circuit of surplus can.

The first step in the operation was to rip off the top of the box. This disclosed a rather nice inductor of large dimensions shunted by a 0.047 μF transmitting type mica condenser. The dc resistance of the coil was about 120Ω.

Figure 1 represents the original contents of the can. Figure 2 represents the least complicated filter configuration that we can develop from our prize. Notice that the shunt condenser has been removed and put into the satin lined junk box for future service. The block in Fig. 2 designated with an "X" is some type of frequency sensitive reactance still to be determined. Essentially the filter will be a frequency sensitive tee paid. The "X" which came out of my junk box was a 300 mH inductor. Using the test setup shown in Fig. 3, it was determined that a 0.1 μF condenser across this shunt "X" would resonate the filter peak around 900 Hz. The driving impedance of the audio generator shown in Fig. 3 is 500Ω as

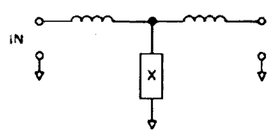

Fig. 2. Simple filter developed from contents of surplus unit.

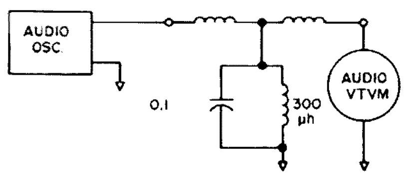

Fig. 3. Audio generator schematic.

-10dB	Peak Frequency	-10 dB	Load
875 Hz	900 Hz	950 Hz	Xtal phones
900 Hz	950 Hz	1200 Hz	magnetic phones

Fig. 4. Filter action for different headphone leads.

is the output impedance of my Lafayette HA-350 receiver. I mention this, as the results of the filter will be different with different driving impedances, so this is a point to keep in mind as you use your hamagination in developing your own filter versions.

Figure 4 shows the filter action for two different sets of headphone leads. Naturally since its mission in life is to drive headphones in my own shack, I checked its performance with its intended load. The chart gives the 10 dB down points. The filter looks broader with the magnetic earphones as a load but for all practical purposes, when evaluated by ear, the difference is masked by the difference in performance between the two types of headsets.

You will notice that the filter attenuation curve is not symmetrical about the peak or center frequency. With such a simple filter, it is not practical to achieve symmetry and the effort to do so would be questionable. If you checked the curve past the 10 dB points, you would find that the attenuation on the low side of the center frequency is considerably sharper than on the high side, which gives sort of an inbuilt single signal effect which adds to the effectiveness of the unit.

If is a simple matter to move the center frequency of the filter several hundred cycles by changing the value of the condenser in the shunt resonant circuit leg.

If you don't want to prowl the surplus lanes you can still try rolling your own using the secondary of a plate-to-push-pull-grid transformer in place of the surplus goodie. Many ham shacks have a spare 88 mH toroid floating around and this could be a starting point for the shunt inductor.

. . .W3KBM■

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ELECTRONIC HEALTH

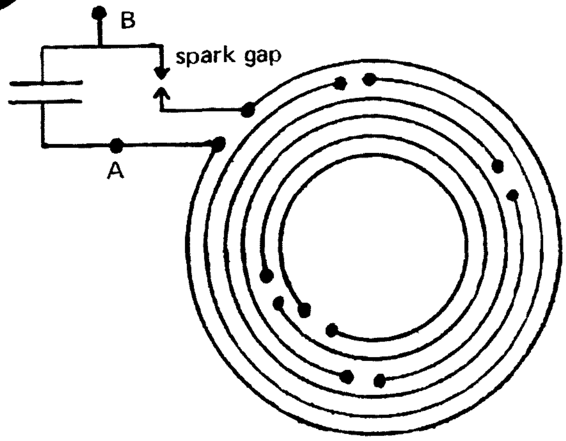

Fig. 1. Tubing may have balls or disks on their ends or strips may overlap for slight fixed condenser effect. Connect the high voltage either to A and B or to A and C. Practically there is no difference.

If there is one thing we readers of 73 have even more in common than our interest in radio I would guess it would be our health in general, though we usually do little about it, and in particular the desire not to die after great pain from cancer. There is something we are qualified to do about it due to our technical knowledge. In fact there is a variety of things we can do about it without resorting to medicines; but a discussion of nutrition, color therapy, reflexology, or Eemans Cooperative Healing or Radiesthesia would be entirely out of place in a radio magazine.

On the other hand, the Lakhovsky Multiwave Oscillator is right down our alley and I feel we might be of genuine service to our fellow man if enough of us made use of this device and it proved of outstanding value. The resulting publicity might then force it to the attention of those needing it most. The Establishment might then be induced to use it.

From many events of the past we may assume or infer that those most qualified to practice a given art or science are also those most reluctant to honestly examine, or test without prejudice, anything new in their respective fields. Torture, ridicule or persecution is often the reward reaped by the innovator.

Due to the stubborn attitude of the orthodox the Lakhovsky Multiwave Oscillator met with acceptance by only a small minority and only while he lived to promote it. Before he died, during WW2, Lakhovsky developed a theory that the individual cells in our bodies contained a nucleus that oscillated at some frequency much as a wire circuit would.

He further reasoned that these oscillations become weak in ill health and could be assisted back to health by artificial stimulation. His first efforts employed the wearing of oscillatory circuits excited by random radiations. These devices were worn as bracelets, belts, anklets, or necklaces. These proved successful but were slow acting. The next step was a powered unit.

Any inductance shunted by capacitance, stray or lumped, will oscillate when externally excited or shocked into oscillation. The belts and bracelets must have therefore been a form of such a basic

oscillator circuit. Possibly they were of several conductors of varying lengths with or without more than stray capacity across their open ends.

The Science of Life, by Georges Lakhovsky, gives the theory in detail, but contains no data on construction. The booklet, *Waves that Heal*, by Mark Clement, covers the same ground in less detail. Both have the same pictures of the apparatus and before/after pictures of skin cancer patients. Both have testimonials of several doctors in Italy, France, and England. Larger libraries may have these. I bought my copies from Markham House Press, Ltd., 31 King's Road, London SW 3, England years ago.

The powered unit is essentially a spark transmitter, such as I used aboard merchant ships years ago, tightly coupled to a number of single-turn inductances of progressively smaller diameter from perhaps 20 down to 3–4 in. diameter. The idea is to have as many harmonic frequencies as possible in the powered oscillator and consequently in the auxiliary single-turn oscillating circuits. The conductors or single-turn coils pictured in the books are of copper tubing with little balls on their ends.

One picture shows one turn as the powered oscillator and eleven as auxiliary oscillators. The latter are suspended within the former by silk threads. I mounted mine rigidly by soldering the conductors to screws threaded in ceramic standoff insulators which were mounted on Textolite. I let the ends overlap and used copper strip. There cannot be anything critical about either the number of coils or their dimensions. On shotgun reasoning, the more the better.

Although not essential, another set of auxiliary coils were used by Lakhovsky at a distance of 4–5 ft from the first to slightly increase the overall efficiency. As the object is to have many different frequencies, the reflector coils need not be of the same size as the first nor do they need a condenser and sparkgap.

The treatment consisted of having the affected part of the patient focused between the approximate center of the two coils for about 15 minutes while the power is turned on. Treatments were given once or twice a week. There is no feeling of heat or other sensation and this is definitely not a diathermy apparatus.

As the object is to revitalize cells, the oscillator is not a specific for any particular disease, but I expect it would be most effective near the surface of the body. This is just my opinion. Probably its most spectacular use has been to aid in the rapid elimination in skin cancer in little more than a month and general improvement in skin tissue. I used it to cure a skin cancer as well as to stop a severe toothache and other pains.

One must always bear in mind that any treatment, regardless of its effectiveness, is illegal when used by the layman. The "practice of medicine" without a license may even be stretched to include prayer in some states, so beware. The American Medical Association is not famous for searching for and testing inexpensive remedies for cancer or any other ailments. If you think doctors dare be interested, just ask a few!

The wiring diagram just about explains itself. The sparkgap may be almost any well insulated substantial pieces of metal approximately an eighth of an inch apart. Thin wire would soon burn off. The neon sign transformer I use is rated at 10 kV and 30 mA. The capacitor may be a single unit or combination of series-parallel to total from 0.001 to 0.01 μF at two or more times the voltage rating of the transformer used. One can be made of aluminum foil and plate glass or perhaps you have one left over from your old Tesla coil. Surplus mica capacitors may be bought for a tenth of their original price. Remember that condensers of equal capacities must be used if in series, to obtain equal voltage distribution across them without breakdown. Never increase the length of the sparkgap to see how far the spark will jump as it may ruin the condenser or the high-voltage transformer. Both Meshna and Tab had suitable condensers.

I have absolutely nothing to sell in connection with this project. I like my freedom from jail and disease too. □

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Downers Grove IL 60515

EXPERIMENTER'S

One-Tube $10 2-Meter Transceiver

Even in this age of semiconductor sophistication, LSI and varactor tuning, the true dyed-in-the-wool VHF'er sometimes enjoys a little weekend fun working solely from the junkbox. True, the results are not always earth-shattering technological breakthroughs, but they often produce the most-used pieces of equipment in the area.

Such is the history of this embarrassingly simple one-tube 2 meter transceiver. It's withstood the battering of the community's Novices for several years, two field outings and two severe drops to the cement (as evidenced by pronounced dents and an overall appearance not unlike my old '53 Chevrolet). Yet aside from twice replacing the 3A5 tube, it has never required much maintenance.

A look at Fig. 1 reveals the product of at least one man's junkbox (mine). Simplicity is the byword. A carbon microphone was employed simply because it was handy, not necessitating a trip to the local parts supplier. The earphones are the vintage 1–2 kΩ magnetic type, used for the same reason. A multitude of possibilites exist, though, for the reader not desiring to make a straight carbon copy – hence the title of this article. An additional audio stage could easily produce room-filling volume. Conventional crystal oscillators could be worked in to produce rock stability. The tube could be replaced entirely by a VHF transistor. But then it wouldn't be a junkbox project.

In the circuit shown, the right-hand triode section of the 3A5 functions as a 144 MHz oscillator on transmit and as a two-meter superregenerative detector in the "receive" position. The left triode section operates as a headphone audio amplifier during "receive" and as a microphone amplifier/modulator when during "transmit." Switch S1 acts as the manual T/R.

Dc power, as evidenced in the diagram, is such that full battery operation could be supplied for portability if desired. Although rf power input could be appreciably higher if more voltage is applied (up to 80–90V dc), resultant radiation when in the receive position might prove objectionable. A great deal, of course, depends upon the antenna configuration being employed

and the degree of 144 MHz population in your area.

Performance

Construction is left pretty much to the builder. As with any VHF project, short to-the-point leads are the vogue. Main tuning is conducted by adjusting the setting of CI. Incidentally, hand capacitance is a factor here – and one that must be reckoned with. For this reason it is advisable to completely house the rig in a small minibox or the like and insure that of physical switching. So be judicious in where you position your components.

In operation, this is no tropospheric DX hound. Like any superregenerative design, the receiver is extremely sensitive to weak signals but is affected markedly by stronger signals on the band. As a result, operation in a highly congested metropolitan area can be disappointing. Not because you're not being heard, but because your receiver will tend to blanket out.

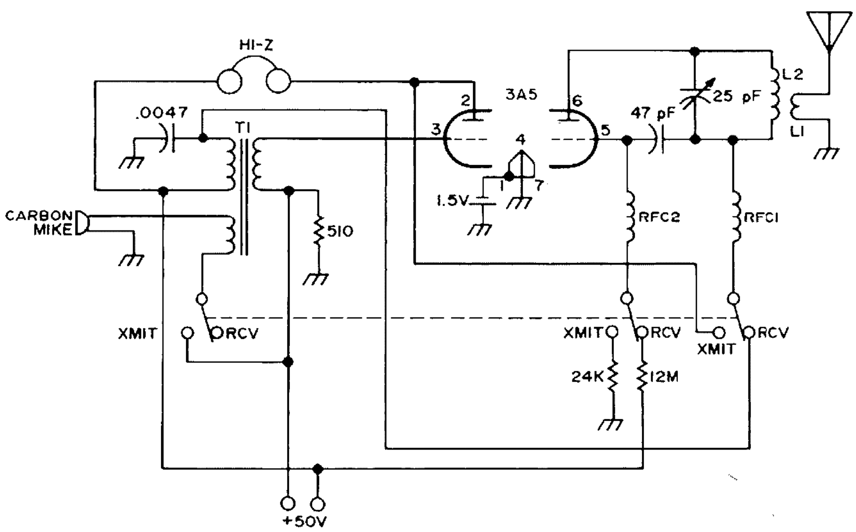

Fig. 1. Circuit diagram of what may be the world's most inexpensive 144 MHz transceiver.

C1 is physically secure. Likewise, L1/L2 are critical and should be mounted to sustain vibration and other environmental considerations without causing a change in operational frequency to take place. Both the variable capacitor and inductors, of course, should be well away from any slight heat that might be generated by the 3A5.

Even if a carbon microphone is employed, it is suggested that this *not* be constructed in conventional hand-held transceiver form. The reason for this is that a wall-mounted mike button forces the user to induce severe vibration both through hand-action and speech – which can affect transmitting frequency. Again, the T/R switch can play a role. You may be listening in one frequency, through the switch, and find yourself transmitting 250 kHz up the band – all caused by the affect

If fed into a highly directional antenna array, however, results can be extremely rewarding. We've had several contacts over distances to 95 miles with this rig, and literally dozens of QSOs within a 40-mile radius. For local work – rabbit hunts, outings, just plain fun, etc – it can't be beat.

Parts List

C1 – 25 pF var.
C2 – 47 pF
C3 – .0047 μF
L1 – 1 turn link of #16 e., ½-in. dia.
L2 – 4-3/4-turns of #16 e., ½-in. dia., ½-in. long
R1 – 510
R2 – 24K
R3 – 12 meg
RFC1,2 – 1.8 μH IRC-CLA
T1 – Triad A-21X
V1 – 3A5

. . . W9HBF■

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Gary, IN 46402

QUESTIONS QUESTIONS QUESTIONS?

A friend of mine who operates on 2 meter FM keeps telling me how much better FM is than AM and SSB. He points out that police, fire department, and other commercial mobile VHF services all use FM. Is FM all that good? It depends on what you are looking for. The big advantage of frequency modulation (FM) is that when the received FM signal exceeds a certain critical level, reception on an FM receiver is virtually noise-free. But when the aim is to get the greatest possible communications range through noise and interference, AM has a 4.2 dB (2.5:1) power gain over FM, and SSB is better than either of them. In addition, FM occupies more channel space than either AM or SSB, which is why the FCC limits commercial FM users to frequencies above 30 MHz. On VHF, where there is room for it, however, the noise-free features of FM make it ideal for local network operations.

As long as I am standing still, I get good reception from my mobile installation. But, as soon as I start moving, grinding and popping noises from the loudspeaker cover up the weaker signals. How can I reduce the noise? By law newer cars have more built-in precautions against radio-frequency interference than the older ones did, but to reduce the noise sufficiently for quiet, high-frequency mobile operation often requires more noise suppression than the manufacturer normally furnishes. One or more of the following suggestions may solve your problems. A set of resistor-type spark plugs usually reduces ignition noise appreciably. Make sure that the alternator rings, brushes, and contacts are clean. Tighten all loose connections and bolts in the car and in the transceiver. Bond together with flexible copper strap or copper braid adjacent parts of the body and frame, such as the engine block to the frame, the steering column and metal rods and control shafts going through the firewall to the firewall. Ground the exhaust pipe to the auto frame near both ends of the pipe. Different capacitor companies manufacture coaxial capacitors of 0.1 to 0.25 μF to bypass the input leads of the ignition coil, alternator (or generator), and voltage regulator, and 0.5 μF capacitors for power leads to panel gages, idiot lights, etc., all of which may radiate noise.

Many of the solid-state devices described in various electronics magazines are built on printed-circuit boards. Can I build them without using the printed circuit board? If so, how? Sure. And you can make them look like printed circuit projects (from the top at least) if you wish. Cut a piece of plain perforated board, such

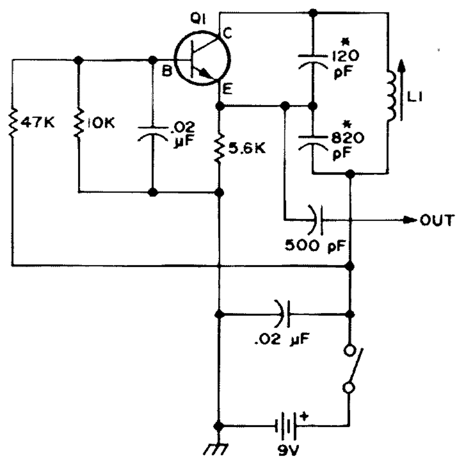


Fig. 1. 455 kHz beat frequency oscillator.

as *Vectorboard* 64AA18, XXXP phenolic, to size with a fine-toothed saw. Mount small components like resistors, capacitors, diodes, and transistors (or transistor sockets) by poking their leads through the holes in the board, and bolt the larger components with screws and bolts. Bolt a small solder lug to each corner of the board and join them together with a square of tinned copper wire around the perimeter of the board for ground connections. Use 20- or 22-gage, tinned copper wire to make the connections between the protruding leads under the board. If the wire is straightened before it is used, it will lay flat against the board without difficulty. After soldering, the extra length can be cut off of the protruding leads. Where connections must cross, insulating tubing may be slid over the leads, or the wire can be threaded through a hole to the top of the board and then returned to the bottom of the board through another hole on the other side of the wire to be crossed.

How powerful a hi-fi amplifier or receiver do I really need for my five-room apartment? Fifteen watts of average sine-wave audio power per channel are usually more than sufficient to fill several interconnected rooms in a home with sound. If the power of the amplifier is rated in the IHF "music power" *watts* however, boost this figure to 25 watts per channel. Actually, how loud a watt of audio power sounds in a given installation depends a great deal on the efficiency of the speakers used and the "hardness" of the room, as well as its size. A room containing heavy, wall-to-wall carpeting and lots of drapes and upholstered furniture will absorb almost three times as much audio signal as a sparsely furnished room with a hard floor and walls. Small "book-case" type hi-fi speakers often sacrifice efficiency to obtain low-distortion reproduction over the full audio-frequency range in spite of their small size. But even under the poorest conditions, 15 watts per channel of sine-wave audio power should produce more than enough sound in a home to satisfy almost anyone, except possibly a deaf "rock music" fan.

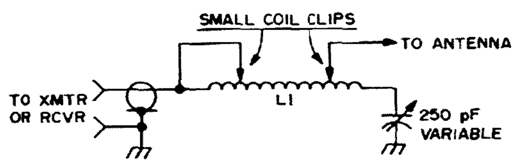


Fig. 2. Wide-range, single-wire antenna coupler for transmitter or receiver.

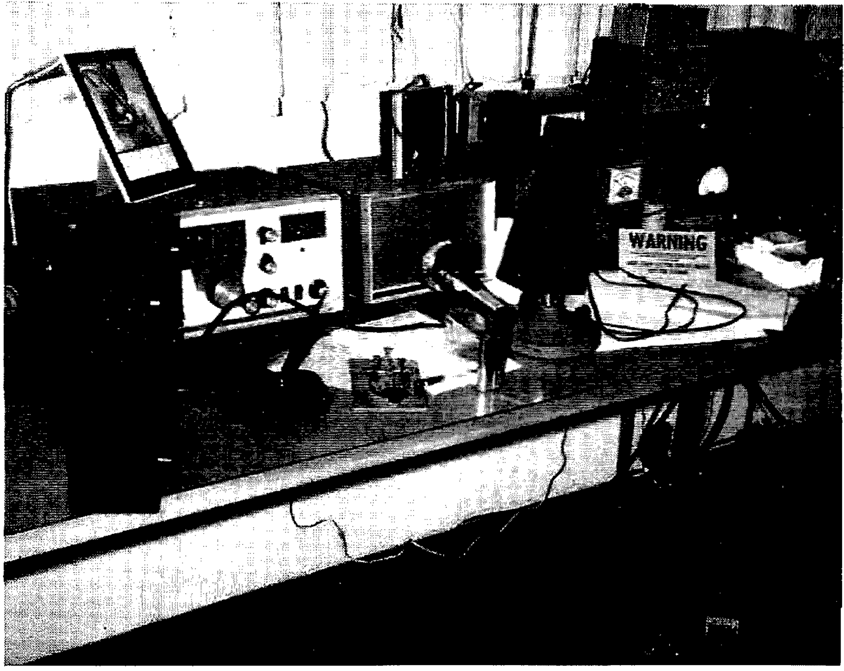
Is there anything I can do to my transistor, all-wave radio to receive code on it? The 455 kHz, one-transistor beat-frequency oscillator (bfo) sketched in Fig. 1 should do the trick. All parts, including the battery, will fit comfortably in a 2-3/4 X 2-1/8 X 1-5/8 in. aluminum minibox. Mount the slug-tuned coil and the switch on one end of the box and slip in the rest of the components wherever they fit. A couple of insulated tie strips will support them, and a solder lug or two screwed to the box serve as ground terminals. Almost any reasonably high-frequency NPN silicon transistor besides those listed on the diagram should oscillate in the circuit. Use a length of flexible, insulated wire about a foot long for output coupling. Tune in a station on the receiver, and with the output lead from the bfo draped over the receiver, adjust the slug in the coil to produce a whistle on the received signal. If the receiver is exceptionally stable, you may be able to receive SSB signals on it with the aid of the bfo; the bfo is quite stable.

Can you design me a wide-range antenna coupler for an end-fed antenna? The coupler sketched in Fig. 2 will match almost any single-wire antenna to a receiver or low-power transmitter on almost any frequency, depending upon the inductance of the coil and the position of the coil tap. As a receiver antenna coupler, adjust the capacitor and coil tap for the strongest received signal. As a transmitter coupler, adjust them for minimum swr on an swr bridge between the coupler and the transmitter.

Mail your questions to: Questions, c/o Herbert S. Brier W9EGQ, Box 678, Gary, IN. 46401.

. . .W9EGQ/KHD 6961■

FOR XYLs and YLs ONLY:



UNDERSTANDING YOUR AMATEUR RADIO OPERATOR

THIS IS A SHACK.
A SHACK IS FOR TINKERING.

Joan Fury,
XYL of Art WA6JLJ

Many articles have been written on how to build amateur radio equipment, how to put an antenna up, how to this and how to that. But few, if any, have been written on understanding the amateur radio operators themselves. So I thought I would undertake this task.

There are many advantages of having a hobby of amateur radio. They are: (1) educational, from the standpoint of gaining technical knowledge regarding radio; (2) social, from the standpoint of family picnics, dinners, or a night out with the boys; and (3) civic minded – just take the case of hurricane Camille and others.

However, with all of the good qualities, there are some idiosyncrasies involved with the world of hamdom which I am sure most wives of hams will recognize as I set them out. Before I start, I realize there are many female ham operators, and to these, I give a hearty "Bravo!" But this article is specifically written for the rest of us females who are really not so inclined as to take up ham radio as a hobby.

Having been married to an amateur radio operator for about eight years, I feel qualified as something of an "expert" on the subject. I remember how excited my OM was when he installed his first radio in the car and how he wanted me to speak into the microphone to the unseen body at the other end. He was the only one who seemed to hear a voice. All I heard was some type of mumbling and static at the other end. Later, it was explained to me, in much detail, as to how the radio needed to be "tinkered with" and then it was going to be really something. This should have been my first clue – the idea of "tinkering . . . " If your husband is a true ham, as mine seems to be, then you know exactly what I mean. They are forever tinkering with something, working ever so hard to get something right, only to trade it for something that doesn't work quite as well – and so the cycle continues. An interesting thing to note: If this breed of ham does buy a new piece of gear, nine times out of nine he has to modify it.

My OM's shack first began in our card table, along with the entire lower portion of a sliding cabinet in the living room. It has now grown to one bedroom filled with test gear, radios, etc., and one entire wall of the garage. But I really don't mind because my OM has "seen the light" in the reasoning of keeping things neat. We have plastic shoe boxes and plastic cabinets filled with things and stuff.

I spoke before of test gear, and I would like to expound on that subject a bit. One day I ventured into the shack and found my OM working on a piece of gear with schematics all around. Upon asking what he was doing, I got the reply that he was building a piece of test gear (let's call the piece of gear "A") so he could test another piece of gear that he was working on (let's call it "B"). It seems that in the middle of building "B", he ran into a snag and had no way of testing it so he had to stop building "B" and start building "A" so he could test "B". At which time, I patted him on the head and left the room before the unknown "C" came into the picture.

A true ham has the instincts of a pack rat. No doubt you know that a pack rat collects shining objects with which to feather his nest. A ham also collects shining objects to feather his shack with, such as transistors, resistors – and the list is endless. A Playboy calendar might also be found in the shack from time to time. And of course, there are the boxes and shelves of transformers which weigh a ton, or seem to.

There is one saving feature: auctions! An auction is an occasion when an item is finally sold, much to the pleasure of the wife, but somehow or other the ham feels he has to come home with some goody, thus continuing the cycle. I remember my first auction; it was held before we were married, and we went to it as a Friday night date. When I heard my husband-to-be was taking me to an auction, I thought how nice and was looking forward to it. (I thought it was going to be a real auction – you know, the kind with antiques, furniture, etc.) Anyway, when we arrived at the

auction, I do not think I have to tell you what I saw – anything but antiques as I know them.

I have been tempted to get into ham radio several times, but just as I am getting enthusiastic, "we" get another piece of gear, and somehow my enthusiasm wanes, and I go back to sewing and cooking.

By no means do I mean to belittle the amateur radio world. As I said at the outset, it is a worthwhile hobby. But to the YLs and the XYLs of amateur radio operators, I just wanted to say that I am with you and please treat your amateur radio operator kindly and realize that his little idiosyncrasies are not his alone.

Even if you don't aspire to become a dyed-in-the-silk ham-type XYL, you can become a "quasi" ham by assimilation. You do this by learning his language. Here are a few of the trickier terms:

Hamshack: Not to be confused with the tool shack. The hamshack is usually resplendent with radio gear, most of which is in various stages of modification or repair.

Gear: Not to be confused with a gear in a car or watch. Gear in this case means anything having to do with radio equipment, from the tiniest part to the biggest tower.

Ham: Not to be confused with the meat. This is of the two-legged variety and should be given encouragement if he looks puzzled.

Auction: When this word is mentioned by a ham, it means an auction where absolutely worthless radio gear is sold.

OM: Name given to a male type person who is involved with amateur radio.

XYL - YL: Name given to a female type person who is either married or not married to an OM.

Modify: Usually means, according to Webster's: "To change *somewhat* the form or qualities of." However, in ham language, it means to change beyond all recognition.

Tinkering: The beginning stages of modification.

Static: Secret code that only a true ham can communicate with.

Goody: Something usually without worth, bought at an auction.

Fury■

HIGH POWER SURPLUS FOR 2M FM

by Ken Sessions K6MVH

The days of the surplus buy aren't over yet. In the March and April issues of 73 Magazine, Newsome Electronics* advertised a military surplus rf power amplifier made by Motorola: a rated quarter kilowatt for $350, brand new. There were so many attractive features – not the least of which was the fact that a full modulated FM signal could drive the unit to full output – that I promptly sent off to Newsome an order for one of the power amplifiers. It came about 10 days later.

As shown in the photograph, the unit is very military looking, but exceptionally clean, both in general design and overall appearance. Despite the trunk-like case, the amplifier set consists of nothing more than a control panel and the two basic commodities of all such amplifiers: a husky and conservatively rated power supply and the power amplifier itself.

The power supply, which bears the military designation PP-638/U, is shown schematically in Fig. 1. It is a full-wave, choke-input power source that provides 1000V under full load (250–300 mA). Adding a 4 µF capacitor at the input of the power supply filter choke will increase the output voltage by some 400V. You can actually get almost any kind of voltage you want out of the power supply if you feel like making the necessary modifications. Throwing out the rectifier tubes and replacing them with silicon diodes will contribute to increasing the voltage – and of course you can use a bridge rectifier circuit in place of the full wave. If you do go the whole route, you'll have to make other changes, too – like replacing the final tubes with 4X250Bs, for example. I had a couple of the 250Bs, but I couldn't see going to all that trouble for a couple of dB. I just put a 4 µF capacitor at the filter input and stopped there.

You can't even do what I did without compensating the circuit for the change you made. The unit is overvoltage protected, and a key relay won't trigger if

*Newsome Electronics, 19675 Allen Rd., Trenton MI 48183

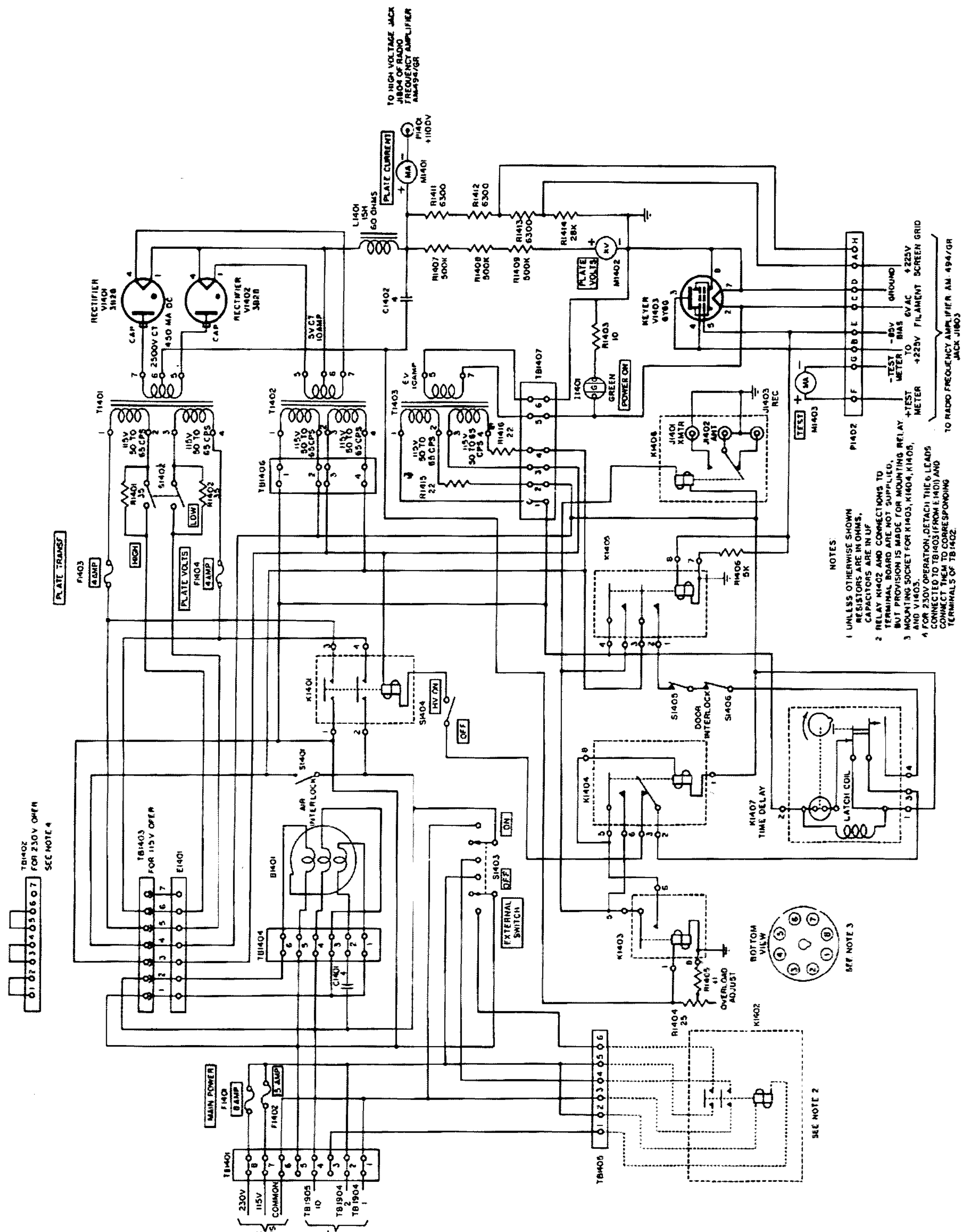


Fig. 1. Power supply schematic.

the voltage exceeds 1100V at a specific point. To change the setting of the overvoltage protection circuit, all you need to do is turn a pot (R1404) on the rear of the cabinet. Full clockwise rotation of the pot defeats the function of the circuit.

Like nearly all pieces of military gear, this rf amplifier has more circuits built for idiot-proofing than it has for performance of its intended function. Several other amateurs in this area sent for the Newsome amplifiers, and a few had trouble getting high voltage. Well, so did I

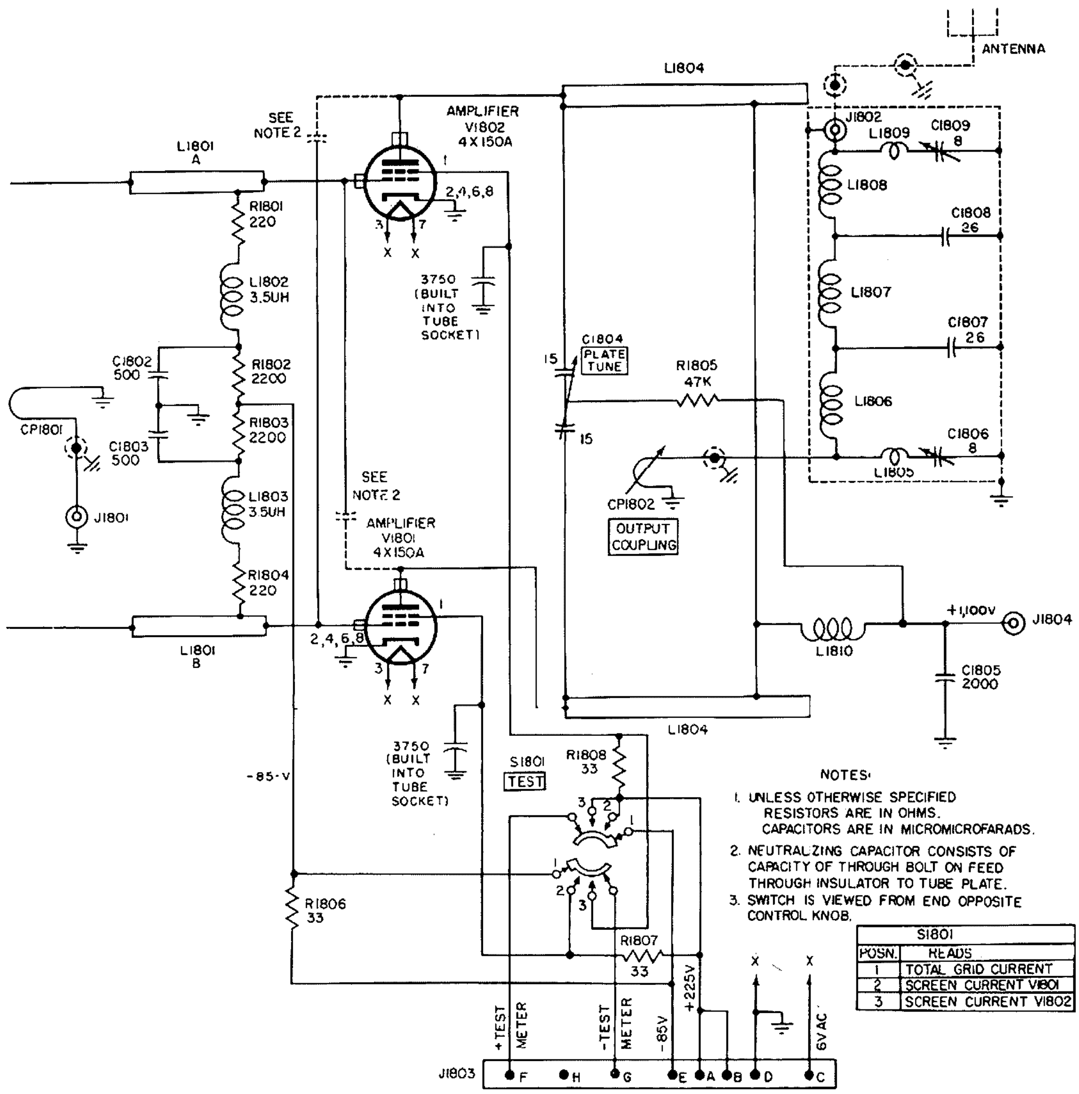


Fig. 2. Radio frequency amplifier, schematic.

until I started looking through the manual. If the drive level on the grid of the final amplifiers drops below 10 mA, the keying relays won't pull in. The relays, once keyed, will stay energized, though, even if the drive falls to around 5 mA. But if you drop power on the input, you won't get the rf amplifier going again until you can generate 10 mA of drive. It seems to require about 8W of transceiver power to get 10 mA of grid drive.

A power supply overload control also disables the plate and screen supply to the amplifier when the plate current reaches an excessive value (420 mA). While this does provide protection against momentary overloads, it does amount to a pain in the neck when you're trying to get the thing tuned up. Your best bet is to use the tune position of the set to get everything in resonance, then switch over to high power. When you do this, it will take only a bit of tweaking to redip.

Figure 2 shows the schematic diagram of the amplifier portion of the system (AM-494/GR). The unit comes equipped with a pair of 4CX150A tetrodes, the same lineup Johnson used in its Thunderbolt kilowatt unit. These are extremely rugged tubes and are capable of comfortably running a full thousand watts input by themselves. The big secret is keeping the bottles cool – which is no problem with this amplifier because an efficient air-blowing system is built right in. Construction of the tube sockets is such that the cooling air circulates from the tube bases up past the ceramic envelopes to

the metal cooling-fin structure of the tubes.

The capacitors shown by broken lines in Fig. 2 consist of the inherent capacitance from the tube plates to the bolt and nut on a feedthrough insulator; these small capacitance values serve to partially neutralize the grid-to-plate capacitance of the tubes. Since there is nothing critical about the value of the capacitance, adjustment should not be required. If for some reason it becomes necessary to change the neutralization capacitance, washers of various diameters could be used; but the process would not be fun at all, and the hit-and-miss aspects of it should go a long way toward dissuading prospective tinkerers.

To get the amplifier going, connect a clean rf signal of 8–20W into the input (CW or FM only – this is NOT a linear amplifier). Turn the power switch of the amplifier on, but do not apply plate voltage. Put the TEST switch in the GRID position, and adjust the GRID TUNE control on the amplifier until the TEST meter indicates at least 10 mA of drive. If you can't get an indication of 10 mA, forget about switching on the high voltage; if you do get at least 10 mA of drive, put the PLATE VOLTS switch on the amplifier in the LOW position and switch on the high voltage. From here on, the tuning is exactly the same as your own transmitter: peak the coupling, dip the plate as long as you have a nice smooth swing on the PLATE CURRENT meter. If the dip looks a little sluggish, back off on the coupling and dip at a lower setting on the meter. That's all there is to it.

With a capacitor input supply, the final should dip at around 300 mA. If you are running 1.6 kV, this is a power input of 480W. Assuming an efficiency of around 70%, which is reasonable with class C amplifiers, your power output should be a little more than 325W. And if you've opted to replace the rectifiers with solid-state diodes, you'll get a signal out that will guarantee you at least a watt out for every dollar you've invested. . . .K6MVH■

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Lodi CA 95240

Evaluation of Swan's 2 & 6 meter Antennas

When I decided to operate on the VHF bands, my first consideration was the antenna system – I made plans for this important feature even before making plans for the rig that I use.

One day I heard about a firm in Stockton, California, that made antennas to order – that led me to Oliver Swan's place of business to discuss 6 and 2 meter antennas.

Having worked in the broadcasting business for some years and having met countless lids who try to convince you that they know a lot more than they really do, it was a real pleasure to converse with Mr. Swan for an hour or so about antenna theory. I learned more in that hour than I had ever learned before on the subject. I can honestly say that there are few people who know as much about antennas as does Oliver Swan.

It was agreed that the Swan Antenna Company would construct and install a two-bay array on 50 and 144 MHz for me. At this time I was just in the process of receiving my amateur license and knew few of the local hams. Had I checked around, I could have saved myself some trouble later, as you will see.

In a few weeks, Mr. Swan's crew arrived and installed the antenna system. Since I was awaiting the arrival of the postman with an envelope from Gettysburg, I did not immediately test the installation, but it was an impressive array. The bays were mounted vertically on a nicely welded boom, which was in turn installed in a heavy duty rotor.

At the same time my income tax refund came, so I blew it on a Swan 250-C (no relation, I understand) to get started on 6 meters. When I connected it and applied power, the swr measured about 3:1.

I was advised that the swr on these beams would be well below 1.5:1; so I contacted Mr. Swan immediately. Nobody in his office appeared to be too concerned with the problem – he gave me some suggestions and that was about it.

After about six weeks of operating into a high swr and getting reports of 5–3 from Sacramento, 40 miles away, WB6JJG and I took down the system so that it could be changed to horizontal polarization. While the antenna was on the ground, I decided to check out the reason for the high swr. Securing a 10-ft piece of conduit, I mounted one of the bays on this. Nothing. Nothing in, nothing out. The other bay worked fine. Checking further, the inside of the balun box appeared as if there had been arcing, although the capacitor checked out okay. An ohmmeter check showed an open connection in the feedline to that bay caused by improperly connecting the BNC connector in the wiring harness.

After solving that problem by fixing the connection, I adjusted the coils in the baluns on each bay by tweaking them closer or farther for minimum swr. I was able to get the swr to 1.2:1 with the antennas supported on a fence post, and at the same time, the signal reports came up.

Now these antennas have been up for a year. We have had a considerable amount of rain and wind in the past few months with more expected before summer. The antennas are not quite horizontal now; they're about five degrees askew with a few loose elements and one or two bent directors.

The materials used in constructing the Swan antennas is top drawer – seamless aluminum tubing and other heavy duty hardware. The bolts and clamps could be designed for a little more rugged duty, as evidenced by an early bad experience with the wind and the weather. I was surprised that the high swr was not detected at the factory if a routine test of the antenna were made. Most users of the antennas will install them themselves; I thought the installation work left something to be desired, as evidenced by the rotor rotating on the shaft and the guy wires breaking.

STUDY GUIDE GENERAL CLASS LICENSE

Part VIII Spread The Word

The usual reason anyone wants a ham ticket is so that he (or she) can legally operate a radio transmitter. After all, no license is required to run a receiver, as dozens of shortwave listeners can testify – but they're missing much of the fun!

Since this *is* the normal reason, it's only natural to expect that the FCC examinations for all grades of amateur licenses would include several questions dealing with the theory and operation of transmitters. The expectation is correct, and the General exam is no exception.

So this month we're going to take up six of the questions from the FCC study list which deal with transmitters. The specific questions at hand are:

6. How does frequency tolerance affect band-edge operation?

17. What is a crystal resonator?

25. Describe briefly how oscillators operate. What are the most common types of oscillators and how do they differ from each other?

29. What is the maximum legal dc power that can be delivered to the final amplifier of an amateur transmitter? How is this power determined?

32. What is neutralization and how does it contribute to proper amplifier operation? What procedure should be followed to properly neutralize an rf amplifier?

50. How can the power input to the final amplifier of an SSB transmitter be determined?

As usual, we won't attempt direct specific answers to these highly specific questions. Instead, we'll rephrase the questions to cover more ground and thus examine the whole area in some depth. This procedure, hopefully, will give you a better chance of passing the exam in case they switch slightly and use different questions which cover similar material.

For starters, we can ask, "What makes up a transmitter?" This will get us off the ground, putting some of the bits and pieces of knowledge we've picked up in the preceding chapters of this study course into something resembling an actual operating gadget. In looking at this question, we'll discover that a transmitter includes, among other things, an oscillator and an amplifier. Logical follow-on questions, then, are, "How does the oscillator operate?" and, "What's unusual about the amplifier?" By the time we've explored these two questions, we'll be fairly solid on the theory end of transmitters, but there's still something to learn about rules, so our final question will be, "Why and how is power measured?"

While our entire emphasis in this installment will be on the applications of the circuits we are examining to transmitters, many of the circuits are also used in receivers, and when we get around to receiver theory we'll be referring back to this section.

Sound like enough for this time around? Let's get at it, then.

What Makes up a Transmitter?

In the most general sense of the word, a radio transmitter is any device which transmits radio energy. The first transmitters

used spark gaps to generate this engery, and Marconi spanned the Atlantic with the output of a spark gap transmitter. We've still got some of them around, too, although they're not legal for deliberate use as transmitters (and haven't been for nearly 50 years) – we call them automobiles, and their rf output we call "ignition noise."

However, when we speak of a radio transmitter these days we mean a collection of circuits and apparatus which is used to generate and transmit radio energy – hopefully in accordance with federal and international rules and regulations. Almost all transmitters in action today have five major functional portions,although they may differ in most of their details.

These five major parts of any modern radio transmitter are an oscillator, an amplifier, a power supply, control circuits, and a modulator.

The oscillator controls the radio frequency upon which the transmitter operates, by generating rf energy at some specific frequency. The amplifier boosts the power level of the oscillator's output up to the desired level to be fed to the antenna, and in many cases changes the frequency in some specified manner while doing so. The power supply furnishes operating power to the rest of the components. The control circuits permit the transmitter to be turned on and off, and otherwise to be controlled during operation. The modulator permits the transmitter to carry information; it's a subject unto itself, and we'll look at it next time around.

Figure 1 shows these major components of the typical transmitter in block-diagram form. A small portable transmitter such as those found in hand-held portable (Part 15) transceivers may have only one transistor in the oscillator, another in the amplifier, use a 9V battery as the power supply, have only an on-off switch for control, and use the receiver audio section as a modulator, but all five of the major functions are there. Similarly, a 50 kW broadcast transmitter may use three or four tubes in its oscillator, a dozen or more in the amplifier, have a power supply which takes up the best part of a good-

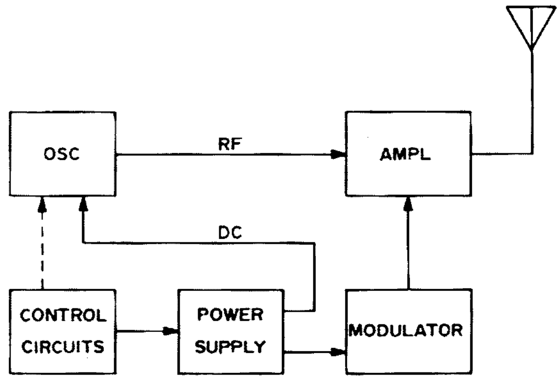

Fig. 1. Every radio transmitter contains these five basic functions, as explained in text. Even a CW transmitter has a modulator.

sized room, make use of elaborate control circuits, and have a modulator bigger than most entire ham rigs. Still, only the five major functions are present.

Since the five major functions are present in all transmitters, from the smallest to the largest, and since no transmitter includes circuits *not* represented by the five major functions, it follows that if we clearly understand the workings of these five functions we must have a clear knowledge of transmitter theory.

We have already examined power supplies in general, and there's not much to add that's unique to the power supplies used in transmitters.

In general, transmitters require larger power supplies than do receivers, because a receiver needs to produce only a few watts of audio power as output (less than that if headphones are used) while transmitters must produce up to several hundred watts of rf output power. Since no transmitter is 100% efficient, production of a 700W output signal (about the best that can be achieved within the ham power limit) requires around 2 kW of dc from the power supplies. The exact ratio between rf output power and dc input power depends largely upon the type of modulation used and is not really important at this stage anyway. The key and pack much more wallop.

In fact, one of the leading ham radio experimenters of all time (Ross Hull, the discoverer of VHF tropospheric propagation) met an untimely death from a transmitter power supply which he was using to power a homebrew TV receiver (in 1934).

Something shorted out and the full power supply output got into his headphones.

The moral is that safety must be the first watchword in all dealings with transmitter power supplies. Interlock switches to prevent access to the power supply circuits while power is on are a good idea, and so are hefty bleeder resistors across all filter capacitors.

Because of the high power levels involved, most transmitter power supplies make use of choke-input filtering, together with full-wave rectification. Mercury-vapor rectifiers are often used in preference to high-vacuum tubes, but high-voltage silicon power diodes are now replacing them. All these steps are taken to reduce power losses in the power supply itself. Yet, even with the most efficient practical power supply circuits, getting 2 kW of dc for the rest of the transmitter often requires the expenditure of 3 to 4 kW of ac from the power line.

The control circuits of a transmitter usually tie in rather closely with the power supply, since they include the off-on switches as well as other operating controls. These circuits differ greatly from transmitter to transmitter, and are often custom designed for each station installation.

One feature frequently found in a transmitter's control circuits is the provision of time-delay relays which delay application of high voltage to the transmitter until after grid bias voltages are applied, and hold back the grid bias until the filaments have warmed up. This greatly reduces stress on the tubes of the transmitter.

On-off switching for the transmitter is usually accomplished by controlling plate voltage to the amplifier. This permits instant changeover from receiving to transmitting, since filament and bias voltages are left on at all times while the station is in use. The same control usually handles antenna switching from receiver to transmitter as well, to permit single-switch operation of the station.

Since the control circuits do vary so greatly from station to station, and are normally just simple power switches in essence (even though they may be hooked together in complicated ways), the license exams do not cover control circuitry – and we'll drop it too.

The modulator is the essential part of the transmitter so far as communication is concerned, but it's a separate subject and will be our target in the next chapter. Its purpose is to put any information to be transmitted by the station onto the "carrier wave" generated by the transmitter, but this can be done in a multitude of ways. Since we'll be looking at this area in detail later, we'll skip it for now.

Which leaves us with only the oscillator and the amplifier to view in the remainder of this chapter.

The purpose of the oscillator is to establish a single specific frequency upon which the transmitter will operate. It accomplishes this purpose by generating an rf signal at this specific frequency, or some other frequency related to it. Output of the oscillator is at very low power level, because any attempt to get high power from an oscillator results in less stable frequency control, and the whole purpose of the oscillator is to provide stable control of the transmitter's frequency. As Robert Heinlein delcared in one of his better science-fiction novels, "there ain't no free lunch." We want stability rather than power from the oscillator, and so we must accept low power output as the price of the meal.

However, the transmitter itself must provide power, and so the amplifier comes into the picture. The amplifier takes the minute output of the oscillator, and brings it up to the power level we desire. Rules say that we must never use more power than that "necessary to maintain communications" – but the judgment of what constitutes "necessary" power is left to the operator, and somehow it always seems to work out that "necessary" means "as much power as you can afford." This leads to the rather ridiculous situation of using a 1 kW station to talk across town, while 1W transmitters are capable of covering the globe, but that's one of our freedoms as hams.

Since the purpose of the amplifier is merely to boost the power of the oscilla-

tor's output, the amplifier must not introduce new frequencies of its own into the signal. This requirement leads to certain complications in the amplifier portion of a radio transmitter which are not found in amplifiers for more general uses.

How Does The Oscillator Operate?

We've said several times here that the oscillator "establishes" a single specific operating frequency for the transmitter by generating an rf signal. Some time back, though, we discovered that all electrical energy with which we deal in ham radio comes either from the chemical energy in a battery or the physical motion involved in an alternator or generator, and an oscillator has neither of these. How, then, can it "generate" a signal?

What really happens is that the oscillator *converts* dc energy from its power supply into rf energy at some specific frequency. Far from actually generating anything, the oscillator dissipates a large part of its input power as heat – but the rest is converted from dc into rf.

To see how this happens, we'll have to back up a bit and think about amplifiers. You'll recall from our previous installment that the purpose of any amplifier is to boost the power of its input signal to a higher level.

In a normal amplifier, we feed the input signal in from somewhere else, and do as we will with the higher-powered output signal.

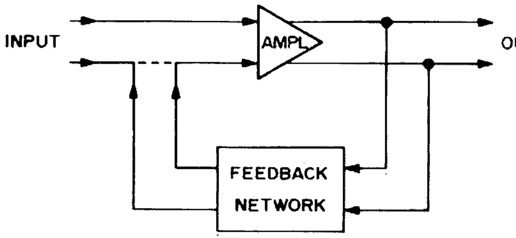

Fig. 2. When a part of the output of an amplifier is fed back to the input, effective characteristics of the amplifier are greatly changed. Normally, only a small fraction of the total output is fed back; function of feedback network is to cut total output down to desired "feedback fraction" for feeding back, and to determine phase of feedback signal with respect to that of input signal.

But what would happen if we took a little of that output signal and fed it back in as an input, as shown in Fig. 2?

Many things might happen. For instance, if the phase relation between input and output is exactly reversed, so that the output signal reaches its positive peak at exactly the same time that the input signal hits negative peak, and if the feedback signal is a small enough fraction of the total output, the amplifier's gain will be reduced, its frequency coverage increased and distortion reduced. This is called "degeneration" or "negative feedback," and is widely used in hi-fi circuits to minimize distortion of all types.

The cathode follower and grounded-grid amplifier circuits are both examples of negative feedback in action.

If the feedback fraction is larger, the apparent behavior of the amplifier will be greatly altered. The differences between cathode followers, grounded-grid circuits, and conventional amplifiers are due entirely to the presence of feedback in large quantities.

On the other hand, if the phase relation between input and output is *not* reversed, but is instead kept in phase so that both input and output signals reach positive peaks together, the picture changes.

With a small feedback fraction, the amplifier's gain is increased, frequency coverage becomes narrower, and distortion rises. This comes about because any small change in input signal will cause a corresponding larger change in output signal, and a part of this change in output signal comes back as additional input to reinforce the original change and make it appear larger. Any distortion introduced by the amplifier is also returned to the input, where it is reamplified — and redistorted.

This type of operation is known as "regeneration" or "positive feedback." It's the basis for the regenerative receiver (which produces rather outstanding performance from a single tube or transistor) and also for the Q-multiplier.

The effects of feedback, both positive and negative, are wrapped up in a simple formula. The effective gain of any amplifier which has feedback connected around

it is equal to the "open-loop" gain of that same amplifier (the gain without feedback) divided by what's left when you subtract the product of feedback fraction and open-loop gain from 1. If the feedback is negative, the sign of the feedback fraction is also negative, and the "subtraction" becomes addition instead. If the feedback is positive, the sign of the feedback fraction is also positive, and the subtraction remains subtraction.

That is, if we had an amplifier with open-loop gain of 100 and connected negative feedback around it with a feedback fraction of 0.5%, the product of feedback fraction and gain would be −0.005 times 100, or −0.5 (remember that negative feedback takes negative sign). The quantity to divide by would then be 1 − (−0.5), or 1 + 0.5, which comes out to 1.5 Effective gain of the amplifier would be 100/1.5 or 66.67X.

With the same amplifier, and the same feedback fraction, but using positive feedback, the sign of the fraction would change and the quantity to use for division would become 1 − 0.5, or 0.5. Effective gain is then 100/0.5, or 200. The gain has doubled – but so has the distortion.

With positive feedback, as the feedback fraction is increased for any specific amplifier, the frequency range becomes ever narrower and the gain ever higher. Finally a point is reached when the product of feedback fraction and open-loop gain equals 1. Here the bandwidth of the amplifier becomes virtually zero and the gain is effectively infinite.

When this point is reached, the division factor in our formula becomes 1 − 1, or zero, and division by zero is "illegal." However, we can see what is happening by looking at the gain when the product is just a tiny bit smaller than 1. For instance, with open-loop gain of 100 and feedback fraction of 0.999%, the product becomes 0.999, and effective gain rises to 100/0.001 or 100,000. With feedback fraction of 0.999%, the product is 0.9999 and effective gain is one million. With feedback fraction of 0.999999%, the product is 0.999999 and effective gain is 100 million. You can see that as the feedback fraction increases to drive the product closer and closer to 1, the gain keeps rising at an astronomical rate.

At some point during this rapid rise of gain, no input signal need be supplied to the circuit. Gain is great enough that the random noise caused by motion of the individual electrons within the wires and components of the circuit itself is enough to cause maximum output, and as soon as any output appears that provides all the input necessary to keep things going indefinitely. This self-sustaining circuit is what we call an oscillator, because it oscillates from one state to another continually.

The precise point at which oscillation occurs can be predicted by part of the feedback formula. Whenever the product of gain and feedback fraction become equal to 1, oscillation is sure to result. The oscillation prevents the product from ever becoming greater than 1, incidentally.

This implies that any amplifier can be turned into an oscillator by simply providing enough positive feedback around the amplifier, and the implication is absolutely correct. If the amplifier has no tuned circuits, the oscillation frequency will be determined by the time it takes the amplifier's coupling capacitors to charge and discharge. We call this kind of oscillator a "multivibrator," and it finds wide use in TV, computer, and radar circuitry. We won't go into it here because it's not required for the General class ham ticket.

If the amplifier has neither tuned circuits nor coupling capacitors, then the oscillator has a frequency of zero. This might not seem like much of a circuit to have around, but it's known to the computer industry as a "flip-flop" and provides one of the most popular memory circuits around for information processing. Again, since it's not required for the General class exam, we won't go into this more deeply.

The kinds of oscillators we're interested in right now all do have tuned circuits, and are based upon rf amplifiers. The tuned circuits are adjusted to provide maximum gain at some specific frequency, and it's the gain at this frequency (center frequency) which fits into the feedback formula. Thus, when oscillation occurs, the

oscillation is at the frequency to which the resonant circuits of the amplifier are tuned.

Because of this, we separate the frequency-determining circuits of an oscillator from the rest of it, and call them the "resonator." Requirements for a single-frequency oscillator are, then, threefold. We must have an amplifier, a resonator, and a feedback network.

The feedback network provides the essential feedback, the resonator provides frequency control, and the amplifier keeps things going. These three components of every single-frequency oscillator are shown in Fig. 3.

The purpose of an oscillator in a radio transmitter is to control that transmitter's frequency, and this means that the frequency of the oscillator must be as stable as possible. This requirement for high frequency stability influences all three parts of the oscillator circuit.

Feedback control is essential, because with too much feedback the gain can be 1 at frequencies which are not exactly at the frequency of maximum gain. This permits the oscillator frequency to wander about, which defeats our purpose. For this reason, no more feedback should ever be used than is required to keep the oscillator going.

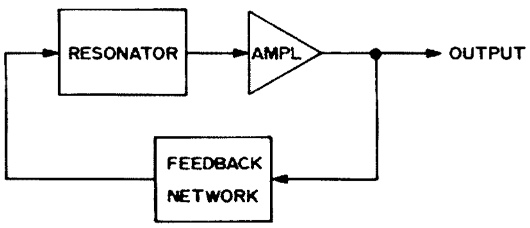

Fig. 3. Addition of resonator to feedback arrangement of Fig. 2, with proper phase of feedback and feedback fraction large enough to elminate any need for external input, produces a tuned oscillator. All rf oscillators in common use share these three components, and the differences between one type of oscillator and another all lie in the manner in which one or more of the three basic functions is achieved.

The resonator, since it determines the frequency in the first place, must be able to stay tuned to one frequency for an extended time period. This is not so simple as it might sound. For instance, the wire of which a coil is wound expands as it heats, and the passage of current through that wire results in heat being applied to the wire. As the wire expands, the coil dimensions change. Even though the change is microscopic, it will still change the coil's inductance and consequently change the frequency to which the circuit is tuned. In practice, this effect may cause a frequency shift of several kilohertz – enough to take a signal right out of a ham band if you're operating near the edge.

When the utmost in frequency stability is required from an oscillator, then, the resonator is hardly ever a simple tuned circuit. Instead, quartz crystals or "crystal resonators" are used. These are thin plates of quartz, ground to precise sizes and thicknesses, which act exactly like tuned circuits to an oscillator circuit but which are far less effected by the circuit's operation than are ordinary coils and capacitors.

Not all frequency-determining crystals are quartz, but the vast majority are. Quartz is one of the most sturdy of many substances which have a property called "piezoelectricity;" this oversized word means simply that these substances produce electricity when squeezed, pressed, bent, or otherwise mechanically deformed, and conversely can be deformed by application of electrical energy. The crystal in a crystal microphone is another piezoelectric substance.

The crystal resonator gets its frequency stability from the fact that it uses *physical* resonance rather than *electrical* resonance, which eliminates one whole level of physical-to-electrical translations from the process.

When an alternating voltage is applied across the proper faces of a crystal resonator, the crystal will vibrate in step with the voltage. If the frequency of the voltage is such that the vibration is "in tune" with the natural vibration frequency of the crystal, the resulting vibrations will be much larger than if it is not.

In other words, the exchange of energy between the electrical and the mechanical states is much more efficient if the electrical frequency matches the mechanical vibration frequency; this means that very

little energy is lost in the transition under such conditions.

If we were to suddenly remove the voltage, the crystal would continue to vibrate for at least a little while, like a Chinese gong which has been struck one time. Each vibration would produce electrical energy which could go back into the external circuit. This is exactly like the energy-swapping role of the LC tuned circuit, and is what makes the crystal resonator act (to the oscillator) exactly like a tuned circuit.

Even though the frequency stability of a crystal resonator is normally much greater than that of an LC circuit, some care is still necessary. Many crystals are capable of acting as resonators at several frequencies, and you have to be certain that you're using the frequency you intended to. The crystal itself can be heated by circuit action, and this will change its dimensions and therefore its frequency. And finally, the dimensions of the crystal itself are always subject to manufacturing and processing tolerances, so that the frequency stamped on the case is not ever exact, but itself has a tolerance. This tolerance must be taken into account whenever you're operating near the edge of a band, or any other time when exact frequency control is important.

Crystal frequency tolerances are usually specified in percent, and a typical tolerance is 0.01%. This means that, in the specified oscillator circuit, the crystal's frequency will be within 0.01% of the marked frequency. The higher the frequency of the crystal, the greater the absolute possible error in hertz. For instance, a 0.01% crystal for 14 MHz might have a true frequency anywhere between 13.9986 MHz (14 – (0.0001 x 14)) and 14.0014 MHz. A crystal to the same tolerance for 7 MHz could have true frequency from 6.993 to 7.0007 MHz. In the first case, absolute possible error is 1.4 kHz; in the second, 700 Hz, just half as much.

This tolerance must be kept in mind when ordering band-edge crystals. The lowest frequency to order, with 0.01% tolerance, for operation in the 7 MHz band,

would be 7.00071 MHz. With maximum low-side error, this would still come out as 7.00071–0.0070071, or 7.0000099 MHz, less than 10 hertz inside the band limit.

The way to calculate the tolerance is to add the tolerance to 100%, then multiply the band-edge frequency by the result if you're ordering for the low end of the band, or divide the band-edge frequency by the result if you're going for the upper end (either way, your answer will be farther inside the band than the exact limit). Then round off the answer in the direction which takes you still more inside the band.

While we've discussed tolerance mainly in connection with crystal resonators, an LC resonator has tolerances too, and the same kinds of considerations apply. Any time operation is planned near a band edge, it's necessary to be certain that you know exactly where that band edge is, and keep your signal on the legal side of it.

The major advantage of the crystal resonator is its stability, but at the same time this leads to a drawback. The frequency of a crystal resonator is difficult to change. Because of this, variable frequency oscillators (vfo circuits) using LC resonators are highly popular.

Both crystal and variable frequency oscillators operate in essentially the same way; the major technical difference is the type of resonator used, and the major operational difference is that the vfo is less stable but often more convenient to use than is the crystal.

Most of the common oscillator circuits come in both crystal and vfo forms, but sometimes different names are applied to the two versions of the same circuit. Since all oscillators used in radio transmitters must include the three basic components shown in Fig. 3, the major differences between different oscillator circuits are the ways in which these components are interconnected. In most cases, but not all, the variations occur in the connection of the feedback network.

The feedback network must couple output back to input in the proper phase, and with the proper feedback fraction, but so long as it accomplishes these two tasks everything else about it is free to vary

without limit. Thus it can be placed at almost any point in an amplifier circuit where it can mesh output with input. Some oscillators (such as the Armstrong and tune-plate-tuned-grid circuits) have it connected to the plate, while others (such as the Hartley and Colpitts arrangements) have it in the cathode circuit.

Figure 4–8 show several oscillator circuits, including those in most common use today. In all these illustrations, the feedback network is indicated by heavy lines.

Figure 4 is the oldest of all oscillator circuits using vacuum tubes, the Armstrong

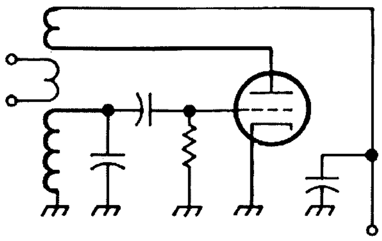

Fig. 4. Armstrong oscillator; feedback is via a "tickler" coil.

oscillator. It works only with an LC resonator, which is in the grid circuit, and the feedback is applied by means of a coil in the plate circuit which is coupled to the grid coil. This plate coil is called the "tickler" and its number of turns is adjusted to vary the feedback fraction.

The Armstrong oscillator is virtually obsolete today, although it's still around in some regenerative detector circuits and sometimes finds use in receiver local oscillators. We include it both for its historical interest and because it spotlights so clearly the feedback function of all oscillators.

Figure 5 is the "tuned-plate-tuned-grid"

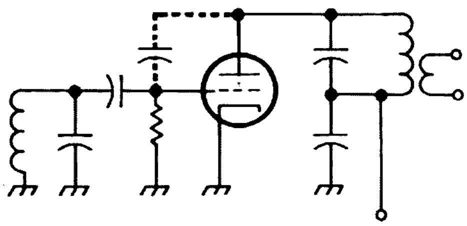

Fig. 5. Tune-plate tuned-grid oscillator feedback path runs through the grid-plate capacitance of tube.

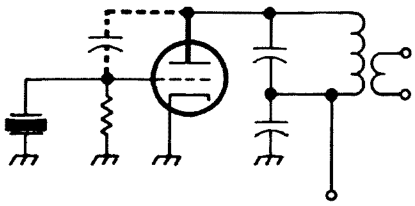

Fig. 6. Miller crystal oscillator is simply a crystal version of TPTG circuit (Fig. 5), with a crystal replacing the grid tank circuit.

(TPTG) oscillator. This circuit is identical to a triode amplifier circuit which has not been neutralized, and oscillates when the plate and grid circuits are tuned to slightly different frequencies. The feedback path in this one is through the tube, by means of plate-to-grid capacitance. While the TPTG oscillator is also obsolete, its basic principle survives in the circuit of Fig. 6.

This circuit, the Miller crystal oscillator, simply substitutes a crystal resonator for the TPTG's tuned-grid circuit. The resulting oscillator is widely used in VHF transmitters. As in the TPTG, feedback is through the tube, and plate-circuit tuning is critical. For best results, the plate must be tuned to a frequency slightly different from the crystal.

The Hartley oscillator (Fig. 7) can readily be recognized by its tapped grid coil and the fact that the cathode returns to the

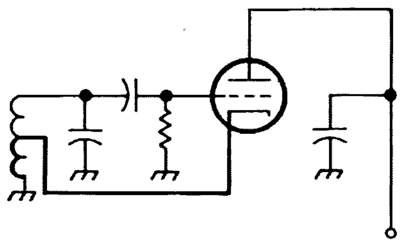

Fig. 7. The Hartley oscillator is always identified by a cathode tap on the coil.

coil tap rather than to ground. Feedback is via the cathode circuit, and is adjusted by varying the tap position (normally by adding or removing turns at the grid end of the coil, which effectively moves the tap down or up the total coil). This circuit is almost universally used for receiver local oscillators, and is also found in transmitters both as a vfo and in a crystal version. In the crystal version, the crystal does not

replace the LC tuned circuit. Instead, it replaces the coupling capacitor from grid to tuned circuit.

The most widely used oscillator circuit at present, however, is the one shown in Fig. 8. This one, identifiable by the two series-connected capacitors from grid to ground and the cathode connection to the junction of these capacitors, goes under at least three different names, which identify the variations shown as A, B, and C in the illustration.

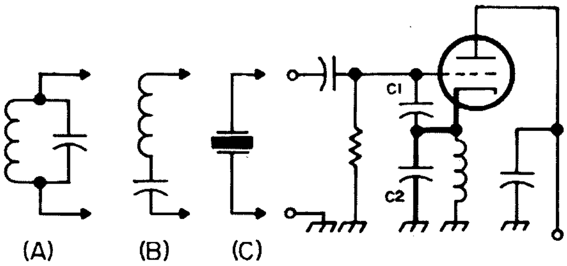

Fig. 8. Capacitance feedback circuit goes under various names, depending on the tuned-circuit arrangement.

All three versions obtain their feedback from the cathode circuit, by voltage-divider action in the series capacitors. The circuit is electrically equivalent to the tapped coil of the Hartley oscillator, but in practice is easier to adjust because either or both of the capacitors may be an adjustable trimmer, permitting convenient adjustment of feedback fraction.

The differences between the three versions all involve the resonator portion of the circuit. When a high-capacitance, low-inductance LC resonator is used and connected as shown at A, the circuit is called a "high-C Colpitts" oscillator. This version is popular as a vfo. It can be designed to permit extremely precise tuning and high stability.

When a low-capacitance, high-inductance LC resonator is connected as shown at B, the result is the *Clapp* oscillator. At one time this circuit was almost exclusively used for vfo's, but in recent years its sensitivity to small changes of capacitance has caused it to decline somewhat in popularity. It's still around in goodly numbers, though.

When a crystal resonator is used as at C, the circuit is called both a "grid-plate" oscillator and a "crystal Colpitts" circuit. Quite possibly more crystal oscillator circuits in use today are of the Colpitts variety than are of any other single type. Since no tuning coil is necessary, the circuit covers a wide frequency range; all that's necessary is to plug in a crystal for the frequency desired. Addition of a tuning coil in the plate circuit makes it easy to pick off any desired multiple of the crystal frequency – a popular feature with VHF operators who often use this circuit with an 8 MHz crystal to get 24 or 25 MHz output direct from the oscillator by taking the third harmonic of the crystal frequency. Stability is excellent, and power output is adequate.

What's Unusual About the Amplifier?

We've already examined the subject of amplifiers in general several times so far in this study course, but the amplifier of a transmitter is a bit different from the common run of amplifier circuit. Our question, then, is "how?"

In a transmitter, the amplifier portion serves several purposes. Most obvious is its action in stepping up the relatively feeble output of the oscillator to the power level desired for feeding to the antenna. Not so obvious is its action of "isolating" the oscillator from external influences.

The oscillator, you see, is a rather sensitive circuit. Almost anything – a change in operating voltage, variations in the applied load, or mechanical vibration – can cause its frequency to change. This is something which we do not wish to have happen, and so we connect an amplifier between the oscillator and the antenna even when the oscillator is capable of delivering enough power by itself, in order to provide a constant load on the oscillator and let the variations of operating conditions all be applied to the amplifier.

While the amplifier is performing both these functions, it must of course not introduce any unwanted output frequencies of its own, nor must it influence the oscillator's frequency, itself.

The result of these requirements is that

the portion of a radio transmitter which we are here calling "the amplifier" normally is not just a single amplifier stage, but instead is a whole string of amplifiers connected end to end. Some are designed to provide isolation, and some for power handling.

The last stage in the amplifier (the one which feeds the antenna) is called the "final" for reasons which should be apparent. Between the oscillator and the final, we may encounter "buffer" stages which are intended primarily to provide oscillator isolation, "driver" stages which are intended to boost power level up to that required by the final as its input, or both.

The buffer stages accomplish their function of providing isolation in several ways. To begin with, every amplifier stage, whether intended as a buffer or not, provides at least some isolation between the stage which precedes it and the stage which follows. Some buffers, then, are indistinguishable from any other rf power amplifier designs.

Occasionally a circuit designer will set up a buffer stage to operate in class A rather than in class C (the normal operating condition for rf power amplifiers). This is done because a properly operating class A amplifier imposes no load on the stage which precedes it, yet is capable of providing sufficient power output to drive a class C stage behind it. If a class A buffer is used, it normally is driven by the oscillator itself; with no (or little) loading upon the amplifier, frequency stability is increased.

Another trick sometimes used in buffer design is to employ a cathode follower rather than a normal grounded-cathode circuit. The cathode follower, with its 100% negative feedback, is noted for its isolation-providing capability. While it cannot produce any voltage gain, it can and does provide power amplification.

One of the most popular techniques used in buffering, though, is to operate the oscillator at some submultiple of the desired output frequency, and then use a frequency-multiplying stage or stages as the buffer.

A frequency multiplier looks just like an ordinary amplifier, but is operated with additional bias (deeper into class C), and its input and output circuits are tuned to different frequencies. The class C operation provides current pulses in the output circuit, and if the output tank is tuned to a frequency twice that of the input, these pulses will occur every other cycle of output frequency. That's often enough to keep things going; multiplication of up to 5 times in one stage is possible.

With the input and output circuits of the multiplier stage operating at different frequencies, isolation between them is naturally better than if they were on the same frequency.

This technique is virtually standard practice with vfo circuits. Most ham vfo's operate in the 1.75 MHz region to provide output at 3.5 and 7.0 MHz, and in the 7 MHz region for output at 14, 21, and 28 MHz. VHF vfo's usually operate in the 8.0 to 8.33 MHz region, providing output at 24 or 25 MHz, which is then multiplied again in the transmitter, by 2 to reach 50 MHz and by 6 to get up to 144 MHz.

Frequency multipliers are also used as drivers, but their efficiency is much less than that of "straight-through" or "straight" amplifiers (those in which input and output are on the same frequency). A multiplier which doubles its input frequency provides about half the output that the same circuit would give in straight through operation; a tripler gives about one third, a quadrupler about one fourth, and so forth.

One great advantage of multiplier stages is that they cannot oscillate because the output signal is different in frequency from the input signal, and so feedback cannot be sustained. A straight through amplifier, on the other hand, is virtually the same circuit as the TPTG oscillator, and if triodes are used it must be neutralized to prevent "self-oscillation." Even with multigrid tubes, which make it possible to operate without neutralization, it's still a good idea to neutralize all straight amplifiers in a transmitter, to keep out of trouble.

Neutralization is the technique of cancelling out all positive feedback from an rf amplifier stage, in order to make it impos-

sible for that stage to oscillate. While the amplifier may have been designed to avoid positive feedback, when the thing is actually built it's almost impossible to get rid of all possible feedback sources. Stray capacitance, power wiring, magnetic coupling between coils, and similar factors bring in feedback whether we want it or not. Careful parts layout can minimize the problem, but cannot eliminate it.

Since we cannot eliminate all the positive feedback, we neutralize it instead. We do this by adding negative feedback to the circuit. The negative feedback cancels out the positive feedback, and the net result is (ideally) no feedback at all. In practice, we usually adjust everything to slightly "over-neutralize" the stage, in order to have a safety factor against component aging and the like, and also because our means of detecting exact neutralization are not completely accurate.

Some of the ills which can be prevented or eliminated by proper neutralization of the amplifier include self-oscillation, erratic shifts of stage gain with small changes in operating frequency, non-linear distortion in modulated amplifiers, and splattering in SSB linear circuits. x Several procedures

Several procedures may be followed to properly neutralize an rf amplifier. All involve balancing out the unwanted positive feedback by artifically supplied (and adjustable) negative feedback, and detecting the balance point by means of a sensitive indicator. The negative feedback is usually taken from the plate circuit to the grid circuit.

Figure 9 shows a typical neutralization circuit, based on recommendations in the ARRL handbook. Capacitor C1 is the normal bypass capacitor for the grid tank, and C2 is the neutralizing capacitor.

Even though we often consider a bypass capacitor to be a "dead short" for rf energy, actually it must always have at least a little impedance at any frequency lower than infinity. C1, therefore, is not ever a true short for rf, and any signals which are applied across C1 must also appear at the grid end of the circuit. C2 is of much smaller capacitance than C1, which means that it has much greater

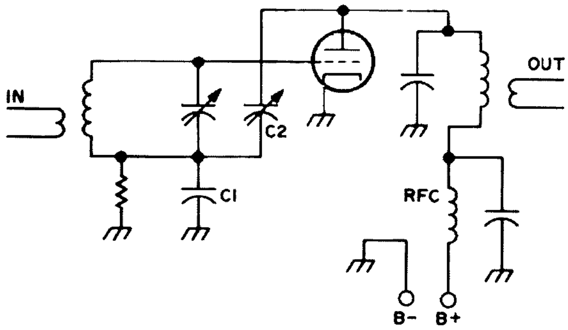

Fig. 9. Neutralization circuit for conventional single-ended rf amplifier makes use of voltage-divider action of capacitors C2 and C1, in series, to provide negative feedback from plate to grid circuit. C1 is normal grid bypass capacitor and C2 is called the neutralizing capacitor. Normally C1's value is fixed and C2 is variable. By adjustment of C2, negative feedback through neutralization circuit is made to balance out any positive feedback from rest of circuit which might cause amplifier to oscillate.

impedance at any frequency, and so the two capacitors together form a voltage divider between the tube's plate and ground. The small part of the plate signal which appears across C2 is thus fed back into the grid circuit, and the capacitance ratio between C1 and C2 determines the feedback fraction. The feedback is made negative, as required, by the fact that plate and grid voltages in a grounded-cathode amplifier are exactly out of phase with each other.

Adjustment is accomplished by varying the value of either C1 or C2, leaving the other's value fixed, until no feedback exists. In most transmitters, C2 is adjusted and C1 is fixed in value. Special "neutralizing capacitors" with very small capacitance and high-voltage insulation are available for this purpose. Alternatively, C2 can be left fixed, and C1's value adjusted. In this case, high capacitance trimmers or variable capacitors are required at C1, but the requirement for high-voltage insulation is minimized.

Whichever of the two is adjusted, the procedures are the same.

One of the most common procedures for neutralization begins with the removal of all supply voltages except filament power from the stage being neutralized. Then a sensitive rf indicator, such as a vacuum-

tube voltmeter with rf probe, is coupled to the output side of the stage, and the stage is driven at full rated input (drive) power. Since no power is being supplied to the stage, any rf which appears at the output indicator must be the result of a feedback path.

While driving the stage and observing the output indicator, the neutralization adjustment is then varied slightly. If indicated output increases, the adjustment is moved in the other direction. With careful adjustment, the fed-through power can be reduced to a level too low to be detected by the indicator, and the stage is then considered to be neutralized. When this point is reached, the positive and neative feedback paths are cancelling each other out, and effectively no feedback at all exists within the circuit.

Another procedure for neutralization eliminates the requirement for an output indicator, but applies only to class C stages in which grid current is metered. Drive power is applied in the absence of power-supply voltage, and the input tuning adjusted for maximum indicated grid current. The output tuning is then swung through its range. If a feedback path exists, the grid-current reading will fluctuate as the output tank tunes through resonance, as it absorbs some of the drive energy via the feedback path. The neutralization is then adjusted until this "flicker" of the meter is eliminated.

Either procedure is accurate enough for all practical purposes. The one using an output indicator applies to all kinds of rf amplifiers, while that using the grid-current meter applies only to amplifiers which draw grid current and which have provisions for metering it.

Not all rf amplifiers are "single-ended;" a circuit called "push-pull" is popular for rf amplifier use, and its neutralization is handled in a slightly different manner.

With a push-pull amplifier, the neutralizing capacitors are connected from the plate of one tube to the grid of the other as shown in Fig. 10. Adjustment is similar to that for single-ended stages, with the added complication that the two separate ad-

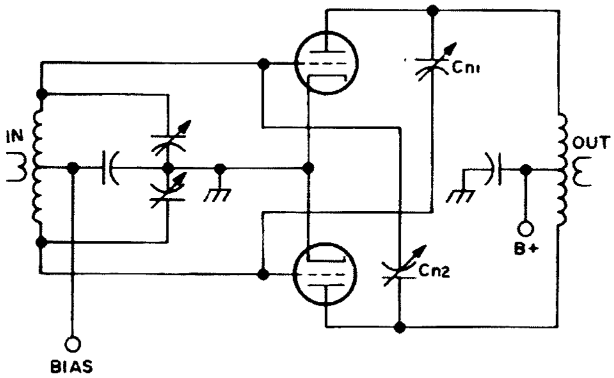

Fig. 10. Neutralization techniques for push-pull amplifiers differ somewhat from that shown in Fig. 9. Here two neutralizing capacitors are used; they connect from plate of one tube to grid of other and vice versa. Since two tubes always operate out of phase with each other, feedback still works out to be negative. The two neutralizing capacitors interact with each other, and adjustment of both must be checked whenever either is adjusted.

justments interact with each other and both must be checked every time.

Why and How is Power Measured?

It's fairly simple to explain *why* the dc power input to an amateur radio transmitter must be measured. Section 97.67 of the FCC Rules and Regulations declares that "except for power restrictions as set forth in 97.61, each amateur transmitter may be operated with a power input not exceeding 1 kilowatt to the plate circuit . . . " The restrictions referred to limit power input in the 160-meter (1.8 MHz) band on a state-by-state basis to prevent interference with the LORAN navigation system, and in the 420–450 MHz band on a regional basis to prevent interference with space telemetry and military experimental radar installation.

Additionally, transmitters operated by Novices are limited to a maximum power input of 75W. In general, though, the power limit for the most popular ham bands is 1 kW. That's what we mean when we say "the legal limit" or "a full gallon."

And even when the limit is lower, such as the 100W permitted for many states in daytime on the 160 meter band, or the 25 to 200W permitted on 160 at night, we still must measure the power to be certain that we never exceed the legal limit for the specific frequency and the specific time at which we are operating.

While we're on the subject of legal limits, it's well to point out that Section 324 of the Communications Act of 1934 includes another legal limit which supersedes that imposed by FCC rules. It's rather specific, too: "In all circumstances, except in case of radio communications or signals relating to vessels in distress, all radio stations, including those owned and operated by the United States, shall use the *minimum amount of power necessary* to carry out the communication desired." (Emphasis supplied.)

That boils down to this: We can never use more power than FCC rules permit, but we cannot use even that much unless it's necessary to carry out the communications.

Unfortunately for the interests of interference reduction, the judgment of how much is "necessary" appears to be entirely subjective, and we have never heard of any operator getting into trouble for using "more power than necessary" – although several have had their licenses suspended and a number of operating awards have been revoked for using more power than FCC rules permit.

The same section of the FCC rules which sets the 1 kW limit goes on to specify just a little bit about how the measurement is to be made. "An amateur transmitter operating with a power input exceeding 900W to the plate circuit," it says, "shall provide means for accurately measuring the plate power input to the vacuum tube or tubes supplying power to the antenna."

Below the 900W level, apparently, an "educated guess" is adequate measurement. In point of fact, the dc plate power input is determined by multiplying plate supply voltage times plate current. Some method of measuring plate current is necessary in order to properly tune the transmitter, and this is usually a milliammeter. At low to moderate power levels, many operators simply multiply the measured plate current by the calculated plate supply voltage, which is a little better than an

"educated guess" but not good enough for high-power use. For 900W or above, it's necessary to have both a voltmeter and a milliammeter on the plate circuit in order to comply with the rule which requires means for accurate measurement. It's also a good idea when operating within 10% of the power limit on any of the bands which have lower power limits.

Now that we know why it's necessary to measure power input, let's see how it is done. We've already indicated the actual technique; measure or estimate the plate voltage, and multiply by the measured plate current. But just how should we measure current?

For ordinary AM phone operation, it might not be too confusing. The plate-current meter of a properly operating phone transmitter remains steady, so you have only one reading to concern yourself with.

But, as we shall see next time out, the actual peak power input to the transmitter is at least half again greater than the indicated dc input, and may be twice as great, depending upon your definition for "peak power input."

Should that concern us in our power measurement? This question has not, so far as we know, been officially answered, but in practice the answer is no. The power input referred to by the FCC is the indicated power input, and the additional power involved in AM phone operation is ac power from the modulator.

How about a controlled-carrier AM rig, in which the indicated plate current gyrates with modulation? Or, worse yet, a single sideband transmitter, which has no input power in the absence of speech, yet fluctuates all over the current dial when modulation is applied?

The answer for both these cases is that the measured power, as indicated on the panel meters, must never exceed the legal limit. The FCC recognizes that instantaneous power peaks may easily go above the limit, but by specifying a quarter-second time constant for the meters they assure that this apparent loophole is not really very big, and put SSB and con-

trolled-carrier operations into the same class as AM (where some of the power, which does not show up on the meters, is "limit-free").

What About FM? The FM operator doesn't get off so well. His power must be measured on a carrier-level basis, just like the AM operator – but he gets no free-power bonus when he adds modulation.

And CW? CW fares poorest of all, because the policy is that power input to a CW transmitter must be measured with the key held firmly down, and this is a condition which is prohibited for any other purpose on the popular CW bands. When CW is being used, the plate current meter fluctuates just as does that of an SSB rig, but the CW operator does not have the freedom to load up to higher power levels and use the "highest flicker" method of reading his power input. He must make his measurement with the key down, and as a result actual measured power during operation seldom exceeds 75% of the "measured" value for official purposes.

To summarize, all transmitter power measurements except those for SSB and controlled-carrier AM are made with the transmitter carrier turned on, but no modulation applied. The plate supply voltage of each tube supplying power to the antenna is measured individually (use care – high voltages are usually present), and the plate current of each tube is similarly measured individually. Legal power input to each stage is the product of that stage's supply voltage times plate current, and the transmitter's power input is the total of the individual power inputs of each stage which provides power to the antenna.

For SSB and controlled-carrier AM, plate voltage and current measurements are performed during normal operation, with modulation applied, and the "highest flicker" of each meter is noted. These "highest flicker" readings are used to determine legal power input to the stage, and as in the other case the power input of the transmitter is the total of all stages feeding the antenna.

. . .Staff■

73 Reader Service Coupon

Now we don't, say that every single reader must buy every last product advertised in 73. We believe that, but we don't say it. The very least every reader can do is to put on a show of interest in the products herein advertised. To make this a simple task, even for the laziest reader (now there is a contest for you!), we have cleverly arranged the advertising index to double as a readers service coupon. All you have to do is tear it out (or photocopy it) and send it in with the appropriate boxes marked. (We have a prize for the most boxes marked . . . a silent prayer of thanks from the publisher). We'll accept postcards, slips of paper, or almost anything else that lists the companies you want to hear from and your address.

No one likes to go into a store without buying something, right? It is the same with these information requests. You will be expected to buy something. Oh, it doesn't have to be a $50,000 antenna system, but it should be something modest . . . a transceiver . . . a linear . . . you know. We'll leave the decision up to you, knowing that we can trust you to do the right thing.

And we are definitely not saying that the use of this service coupon has any curative powers, but we cannot but notice that many readers report remarkable relief from simple backache, headaches, lumbago, and acid indigestion after sending in their coupon. Why take any chances?

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PUERTO RICO	21	14	14	14	7	7	14	14	14A	21	21	21
SOUTH AFRICA	14	14	7	7	7B	7B	7B	7B	14	14	21	14A
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A = Next higher frequency may be useful also.
B = Difficult circuit this period.


AMATEUR
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June 1971
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73 MAGAZINE

#129 June 1971

FEATURES

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Cover: W2NSD/1 antenna. Three elements on 20 meters.

Amateur Radio News Page

JUNE MCMLXXI | Monthly Ham News of the World | 73 MAGAZINE

NEW PROCESS FOR SEMICONDUCTOR MANUFACTURE

A relatively simple, inexpensive new process for making high-performance electronic semiconductors, the result of three years of research, was described by the scientists and engineers who invented and developed the technique at Signetics Corporation, a subsidiary of Corning Glass Works. The company calls the process "D-MOST," for Double-diffused Metal-Oxide Semiconductor Technology.

Devices made with the new process perform better than semiconductors made by all other techniques currently used for manufacturing MOS (metal-oxide semiconductor) devices, according to Dr. David Kleitman, Vice President for Research and Development. The process is practical for manufacturing complex integrated circuits and represents an inexpensive method of making individual semiconductors which are now very expensive. Dr. Kleitman predicted that the new process will be useful for manufacturing new kinds of linear and high-power discrete devices in addition to digital integrated circuits and discrete, small-signal microwave transistors.

Dr. Kleitman pointed out that Signetics has recently introduced to the marketplace a broad product line of digital integrated circuits made with a P-channel silicon gate MOS process. He anticipates a time lag of one year before the D-MOST process is put into full production.

The new Signetics D-MOST process the maximum gain available at that frequency is 10–15 dB. Gain at 2 GHz is approximately 7 dB. The D-MOST transistors outperform JFETs because the D-MOST devices operate with very low feedback capacitance, lower distortion, less cross modulation, lower parasitics, and with greater linearity.

An inexpensive, advanced new process for making many different kinds of electronic semiconductor devices was invented by scientists and engineers in the Research & Development Department of Signetics Corporation. Principal inventors of the process, known as "D-MOST" for double-diffused metal-oxide semiconductor technology, include (left to right) Thomas P. Cauge, Dr. Joseph Kocsis, Dr. Hans J. Sigg, and George D. Vendelin.

Speed of digital circuits is determined by the length of the "channel," which is the area located beneath the gate and situated between the source and the drain. Speed is increased – that is, transfer time is shortened – as

Volunteer Examiners

NOW HAVE 30 DAYS TO RETURN AMATEUR EXAMINATIONS TO THE COMMISSION.

Time in which volunteer examiners must return Amateur Radio Service examinations has been increased to 30 days by the Commission. The action amends Section 97.29(b)(3) of the rules. Examinations were previously required to be back to the Commission in 20 days. The Commission said the time information appearing on the examination envelope furnished volunteer examiners does not conform with the rules. It said that Section 97.29(b)(3) will now specify that the examination papers, either completed or unopened in the event the examination is not taken, shall be returned by the volunteer examiner to the Commission's Gettysburg, Pennsylvania, office no later than 30 days after the date the papers are mailed by the Commission. The date of mailing is normally stamped by the Commission on the outside of the envelope, the Commission added. (Action by the Commission April 8, 1971, by Order. Commissioners Bartley (Acting Chairman), Robert E. Lee, Johnson, H. Rex Lee, Wells and Houser.)

INQUIRY INTO CARRIER-CURRENT RADIO STATIONS

AND OTHER LOW POWER COMMUNICATIONS SERVICES INITIATED BY FCC; COMMENTS ASKED ON OPERATIONAL REQUIREMENTS FOR INTERCONNECTION WITH OTHER SYSTEMS.

An inquiry to obtain further information on the operation of carrier-current radio stations and other low power communications devices (such as miniature transmitters) has been initiated by the FCC. Comments were also invited on proposed rules for those carrier-current systems using interconnection of two or more systems or interconnection of a system with other electronic media such as broadcast stations or CATV. The systems operate under Part 15, of the Rules.

In connection with the inquiry, the Commission adopted a questionnaire to be sent to all carrier-current stations operating under Section 15.7 of the Rules.

The questions generally relate to technical and programming matters, and to the commercial activities of the systems. The Commission stressed that the responses will be used solely for analytical and related purposes, and that the financial data would not be available for public inspection under Section 1.457(d) of the Rules. Comments and information were invited on both the carrier-current systems was required, a new proceeding would be initiated.

In 1969, carrier-current radio stations of Juniata College (WJC), Huntington, West Virginia, and The University of Cincinnati (WFIB), Cincinnati, Ohio, were authorized to expand their activities beyond the campus area. The requests were granted and WJC was permitted to feed its signal to a local CATV service and WFIB was granted authority to engage in networking with other college stations. Since the WJC and WFIB authorizations were granted, the Commission said it has received a substantial number of inquiries and requests similar to those of Juniata College. It noted that the results of a 1969 Ford Foundation study conducted by the Corporation for Public Broadcasting indicate that there has been an overall increase in carrier-current stations, as well as a growing interest in the stations as a communications medium. In view of these requests and the data submitted, the Commission said it believed additional information about the "contemporary carrier-current systems in necessary."

will enable the manufacturer to build integrated circuits which are more compact, less expensive, and better performing than circuits made today, a Signetic spokesman said. UHF and microwave devices now selling for about $50 (junction field-effect transistors, for example) could be manufactured with D-MOST and sold for one-tenth the price, he added.

Popular Techniques of Making Semiconductors

There are two popular techniques of producing semiconductor integrated circuits – the bipolar method and the MOS method. Bipolar circuits are known for their high speed, but MOS circuits are more compact and consume less power; MOS devices traditionally have been slower than bipolar devices.

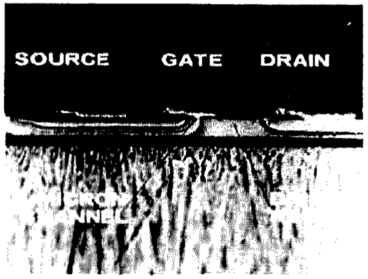
Within MOS technology, there are several processes which are being used today, primarily for making devices used in computer memories. These are known as N-channel, P-channel, ion implantation, nitride, complementary, 1-1-1, 1-0-0, and silicon gate. The new Signetics development currently uses N-channel MOS techniques, but others may be used in the future.

The Signetics "D-MOST" Process and Devices

Termed "D-MOST" devices made in the Signetics laboratoies have exhibited speeds five times faster than ordinary N-channel MOS versions and at least ten times faster than devices made by the P-channel MOS process. The D-MOS devices are comparable in speed to fast bipolar transistors, yet they retain the advantages of high density, low power consumption, and low cost.

In general, either "depletion" or "enhancement" type D-MOS devices can be made. High-frequency microwave devices can be produced as well as logic circuits and memory elements which could be used in computers.

Several D-MOS microwave transistors have been built at Signetics. The transistors operate at frequencies up to a maximum of 10 GHz. The typical noise figure at 1.0 GHz is 4.5 dB, and



A typical Signetics D-MOS transistor was cut apart vertically, and this photomicrograph was made to reveal the cross section of the device. By diffusing opposite dopant impuries under a single mask edge, the need for costly micron-dimensioned masks is eliminated and 1-micron channel lenghs for microwave performance are produced. The process is simple and inexpensive.

channel length is shortened, but with standard MOS process techniques, this has the undesirable effect of lowering the breakdown voltage, a problem which is eliminated with the D-MOST process. Sample D-MOST digital devices exhibit a typical rise time of 210 picoseconds.

W6LS DRIVE AIDS KIDNEY-TRANSPLANT FUND

The Lockheed Amateur Radio Club (W6LS) recently conducted a drive to raise money to help pay for a kidney transplant operation required to keep a 10 year old girl alive. The little girl is Anne-Marie Haddad of Beautiful Downtown Burbank. The club raised more than $250 with donations continuing to arrive. The operation was successful and Anne-Marie is well started on the road to full recovery. Mrs. Marie Welsh (W6JEP) ran this club drive; as the mother of 7 children, she knows that kids need every chance they can get to survive and succeed.

Donations were accompanied by personal notes on QSL cards and Anne-Marie has a fine selection of cards to look at while she recuperates. Donations and cards have been received from 13 states and 5 countries. Henry Radio of Los Angeles, 73 Magazine, and an SWL in El Zagazig, Egypt provided contributions which were entirely unexpected.

tems and low power communications devices from all interested persons including non-commercial and commercial broadcasters, advertisers and educational institutions. These comments should be submitted by June 4, 1971.

A carrier-current station operates on a low power radiation device, and the station signal, a modulated radio frequency signal, is conducted along distribution wires to buildings on a campus. Stations using this technique are required under the rules to use minimum power. The stations were originally permitted to operate under the Commission's 1938 Low Power rules – a forerunner of Part 15 – and were intended to be used as training laboratories for students interested in communications arts, with signal reception limited to the campus.

In 1949, a Notice of Proposed Rule Making was issued proposing a licensing of the stations under rules for broadcast stations. The proceeding was terminated in 1964 when it was found that regulation under Section 15.7 appeared satisfactory. It was noted, however, that if further study

73 REPEATER ON THE AIR

WA1KGO, the 73 repeater on top of Pack Monadnock mountain in Peterborough, New Hampshire, was placed into temporary operation in late April, within minutes after the snow melted enough to permit vehicle travel to the summit of the 2500 foot peak.

The repeater, set up with approximately one half mile separation between the receiver and the transmitter, was running about 30 watts into a new Gam antenna and, according to preliminary reports was furnishing excellent coverage for well over 100 miles in all directions, permitting mobiles in Maine to contact mobiles down in Connecticut.

Tests are being made with a 250 watt amplifier to check the coverage possible with a high power repeater. A Vanguard preamplifier is being installed at the receiving antenna to help equalize the performance of the receiver to the transmitter. If the coverage of the repeater can be extended to 150 miles this would enable it to cover virtually all of New England and Western New York, providing a very useful service.

RADIO CALL BOXES IN 450 MHz BAND FOR HIGHWAY SAFETY APPROVED BY COMMISSION

Rules reserving four pairs of 450 MHz frequencies for the operation of highway radio call boxes in an emergency communications system have been adopted by the Commission (Docket 19001). The action amends Part 89 of the rules and originated in an FCC rule making notice released September 11, 1970. The rule becomes effective May 21, 1971.

Previous Commission policy had generally excluded fixed operations such as call box systems from the 450–470 MHz band. The 450 MHz frequencies allocated for highway call box operation were formerly reserved for base-mobile and mobile-only communications.

The FCC rule changes will allow installation of call boxes along limited-access highways and major highways. Motorists needing assistance will be able to use the call boxes to communicate by voice and tone with control stations. Information about weather and road conditions can also be transmitted by tone from roadside sensor devices to control stations, and this information can then be used to activate highway alerting signs for motorists.

The Commission said that while it was authorizing limited use of 450 MHz frequencies to meet certain immediate highway safety and emergency needs, it had not determined that this kind of system is the most desirable approach to highway safety communications. The Commission explained that it wished to encourage development of a wide choice of possibilities for future communication systems, and that the rules it had adopted allow for the future development of a system of direct communication with motorists in their vehicles.

The Commission made minor modifications in the technical standards it will require for the operation of radio call boxes in the 450 MHz band, and expanded its original proposal, which provided for operation of call boxes only on the National System of Defense and Interstate Highways, to allow licensing of call box systems on any limited-access highway.

Action by the Commission April 8, 1971, by Report and Order. Commissioners Bartley (Acting Chairman), Robert E. Lee, Johnson, H. Rex Lee, Wells and Houser.

NORWAY CONSIDERING REPEATER REQUEST

Per Marienborg, LA8PM, reports that Norwegian authorities are considering a formal request by local amateurs to install a 2m repeater in the vicinity of Bergen. Amateurs in the area are reportedly optimistic about the decision, which is yet to come. If it goes through, Marienborg says, several other groups will make similar applications. And Norway, like the U.S., Germany, and Canada, will have entered the age of repeaters.

BLIND MAY GET CRACK AT THIRD-CLASS PHONE

An inquiry to consider rule changes to provide for issuance of all classes of radiotelephone licenses to blind persons has been adopted by the FCC. At present they can only hold Radiotelephone Third Class Operator Permits.

The Commission said the action was prompted by over-all concern to extend employment opportunities to handicapped persons. It cited in support of its proposal, advancements in technology in the radio electronics field, and experience gained through actual employment of blind operators.

The action, a Notice of Inquiry and Notice of Proposed Rule Making, would amend Part 13 of the rules.

The Commission pointed out that by its order (FCC 67-749) released June 23, 1967, it had amended Section 13.5 to permit blind applicants to be issued Radiotelephone Third Class Permits on the basis of oral examinations. Because of differences in privileges and responsibilities under the first or second class licenses – and because of hazards involved in higher class operator permits – the Commission said at that time that it was not practicable for sightless persons to hold first or second class licenses.

At the present time there are usually two types of operators at a radio station. The "maintenance" operator, who is required to hold a first class license and who is the more technically oriented, makes the internal transmitter adjustments and repairs. Eyesight in this instance is considered mandatory since some of the adjustments must be made while the transmitter is open and there is exposure to high voltage circuits. The "duty" operator's responsibility involves the more routine operation of the transmitter, with adjustments made only to the external panel controls. Eyesight is not mandatory in this instance if the special available equipment is installed by the station licensee to permit the blind operator to accurately less persons as operators and maintainers of transmitters will vary. Apart from the examining function, the Commission stated that it lacks both competence and staff to make selective determination concerning the radio operating or radio technician capabilities of sightless persons.

Written comments are invited to be filed on or before May 24, 1971, and reply comments will be due on or before June 8, 1971.

Because of the general nature of the inquiry, the Commission said no specific rule changes have been proposed. It added that if comments warrant, the rules will be amended or modified as appropriate, without issuance of a further notice, although, if the changes are not considered reasonably simple, there may be further proceedings.

Action by the Commission March 24, 1971, by Notice of Inquiry and Commissioners Burch (Chairman), Johnson, H. Rex Lee and Houser, with Commissioners Bartley and Wells dissenting.

1971 County Hunters CW Contest July 24-25

The CW County Hunters Net invites all amateurs to participate in the 1971 County Hunters CW contest. Portable and mobile operation in less active counties is welcomed and encouraged.

Rules:

1) Contest period: 0000 GMT July 24 to 2400 GMT July 25, 1971.

2) General call: CQ–CH; Exchange – QSO number, category (portable or mobile), RST, state (province or country), and county (U.S. stations). Stations may be worked once on each band and again if the station has changed counties. Portable or mobile stations changing counties during the

MUSIC CITY – C & LC

The second annual Music City Hamfest will be held in Nashville, Tenn. on Sunday, June 20, at Edwin Warner Park: Picnic Area 3. Ample parking, shelters and playground. Bring picnic lunch; or food and soft drinks, ice cream, etc. will be available at the site.

Three main prizes: H W 101 with power supply, H A 460 6m transceiver, and a portable TV set. Numerous other prizes, plus a special ladies' drawing and favors for the children. Main drawing will be at 3:30 p.m.

ONTARIO QSO PARTY JULY 17-18, 1971

All single operator stations are invited to participate in the Ontario QSO Party, sponsored by the Radio Society of Ontario, Inc.

Rules: 1) The time period is from 1700 GMT July 17 to 2400 GMT July 18. 2) There are no power restrictions and all bands can be used. Points will be given for contact with the same station on different bands and/or modes. 3) Ontario stations score 1 point per contact and multiply by the number of ARRL sections and foreign countries worked. Outside stations score 3 points per Ontario station and multiply by the number of Ontario counties worked on each band. 4) Certificates will be awarded to the highest scoring station in each ARRL section. Certificates will be awarded to the highest scoring station in each Ontario county provided a minimum of 25 contacts had been made. A trophy will be awarded to the highest scoring Ontario station. 5) Suggested frequencies: 3560, 3685, 3855, 3909, 7030, 7240, 7290, 14,040, 14,140, 14,225, 14,290, 21,050, 21,300, 28,100, 28,600, 50,250, 50,360, 144,000–144,500 and 145,800 kHz. 6) Ontario stations send QSO number, report and county. Other stations send QSO number, report and section

NEW MEXICO

The Amateur Radio Clubs of New Mexico will sponsor The New Mexico Hamvention 1971 on September 17, 18, and 19, 1971. Convention headquarters will be the Sheraton Western Skies motor hotel on East Highway 66, Albuquerque, New Mexico.

The program will feature technical sessions on antenna theory, SSB, VHF/FM, traffic, MARS, QCWA, DX, solid-state electronics, and many others. There will be exhibits from major manufacturers and representatives will be available.

The ladies program will feature a fashion show by Rhodes Fashions and the theme will be "radio around the world."

There will be many major prizes and loads of smaller prizes. The ladies will have the opportunity at several prizes especially chosen for their program.

In addition to the regular program, there will be tours of the Albuquerque area available to those who wish to participate. We have reserved 120 rooms at the Sheraton for radio amateur guests. Contact Ray Hill, Box 14381, Albuquerque NM 87111.

PENN-CENTRAL HAMFEST

The eighth annual Penn-Central Hamfest will be held by the Williamsport and Milton clubs on Sunday June 13th, starting at 12 noon, at the Union Township Volunteer Fire Grounds on Route 15, Winfield, Pa. Informal atmosphere, bring your own lunch picnic style or use the snack bar. Both indoor and outdoor facilities provided. Auctions, contests, prizes, and swapping. Gate registration fee, \$2.50, XYL and children free, free parking. Talk-in 3940 kHz, 50.4 MHz, and 146.940 MHz FM. For information contact: Al Owen, 2901 Highland Ave., Montoursville RD 3, Pa. 17754.

modes and discussions and reports on different aspects of FM techniques, state-of-the-art front-end stages of VHF receivers, digital frequency indicating modules for amateur use, etc.

For contest rules apply to DJ4JI, for general information and suggestions contact DJ1WM. The area is well covered by the local FM repeater "Steinberg-Relais-DJ4JIA" which receives/transmits on 144.15/145.85 MHz. An automatic tape recorder gives general information for mobile stations every time when signing off.

MICHIGAN

The Delta County Amateur Radio Society has just announced that the annual U.P. Hamfest will be held in Escanaba, Michigan on the weekend of July 31–August 1, 1971.

This gala two-day affair will include a banquet, displays, movies, contests of every nature; all hams are invited to display or sell any items they wish. The U.P. fairgrounds will house the Hamfest. Plenty of parking, and entertainment for the kids and XYLs.

Write B. P. Treml, W8KBZ, Route 1, Gladstone MI 49837.

COLORADO

The Rocky Mountain ARRL convention is to be held in the new and beautiful Antlers Plaza hotel in Colorado Springs on June 19th and 20th. Many prizes will be given away. The first prize will be a popular transceiver. There will be many contests for the amateurs as well as games for all. The ladies will also have many activities including a luncheon on Saturday. Further information may be obtained from Bill King WAØLKD, 2916 N. Institute, Colorado Springs, Colo. 80907.

NEW HAMPSHIRE

The Bow Radio Association and the Contoocook Valley Radio Club, Inc. are co-sponsoring an AUCTION

read the meters and make the necessary adjustments. Only a third class license is required of the "duty" operator, and he may be employed on a full-time or part-time basis at 81% of the AM and 99% of the FM broadcast stations.

The Commission said the purpose of its present rulemaking proceeding is to inquire into ability of sightless persons to maintain as well as operate the radio station as required of a higher class operator, and to examine available technologies which would permit best use of the sightless person's ability. It said comments should be addressed to such matters as responsibility for personal safety from shock hazards; availability of safety devices for transmitter maintenance by sightless operators; restrictions for first or second class licenses for issuance to blind persons; should the maintenance function included as part of the higher classification be deleted from any blind operator classification; and what factors, other than operating or maintaining radio transmitters, would render the first or second class license desirable or advantageous, such as the fact that certain electronic equipment manufacturers or users require the employee to hold a particular operators license either for hiring or promotion; and should the blind operator be classified in an "ungraded" type of classification identified only by the highest number element examination passed, and be permitted opportunity to seek employment in the broadcast field commensurate with his own physical and mental abilities.

The Commission said it must be recognized that effectiveness of sight-

KANSAS CITY

KCØKC has been assigned by the FCC to be used July 1 through July 5, 1971 by the Independent County Hunters at their big convention at Kansas City, Mo. 14336 kHz and other frequencies will be used. QSL via WAØWOB.

contest may repeat contacts for QSO points. Stations on county lines give and receive only one number per QSO, but each county is valid for multiplier.

3) Scoring: QSOs with fixed stations are 1 point, QSOs with portable or mobiles (categories P or M) are 3 points. Multiply the number of QSO points times the number of U.S. counties worked. Portables and mobiles calculate their score on the basis of total contacts within a state.

4) Suggested frequencies: 3575, 7055, 14070, 21070, and 28070 kHz.

5) Certificates will be awarded in three separate categories:

F) Highest fixed or fixed-portable station in each state, province, or country with 300 or more points.

P) Highest station in each state operating portable from a county which is not his normal point of operation with 300 or more points.

M) Highest mobile in each state operating from 3 or more counties with a minimum of 15 QSOs per county.

6) Logs must be complete showing category, date/time in GMT, stations worked, exchanges, band QSO points, location and claimed score. All entries with 100 or more QSOs must include a check sheet of counties worked. Enclose SASE if results are desired. Logs must be postmarked by September 1, 1971 and sent to CW County Hunters Net, Jeffrey P. Bechner, KØWNV, 42 East Signal Drive, Rapid City, South Dakota 57701.

INDIANA

FM HAMFEST Sunday August 1, near Angola, Indiana. Big prizes, free flea market, entertainment for the ladies and kids. Picnic grounds, campsites, boating, food, soft drinks available, rain or shine. Call-in freqs: 146.34/146.76, 146.94, 52.525. For information contact Fort Wayne Repeater Assn., Box 6022, Fort Wayne IN 46806.

or country. 7) The general call to be used is "CQ ONT" on CW, and "CALLING ANY ONTARIO STATION" on phone. 8) Logs should be postmarked no later than Aug. 31, 1971, and sent to "Contest Chairman, Radio Society of Ontario, Inc., P.O. Box 334, Toronto 18, Ontario." Stations sending an SASE will receive a copy of the results.

MISSISSIPPI

The Jackson Co. hamfest will begin 9 a.m. CDST on July 24 at the Mississippi fairgrounds. A full schedule of events is planned and a Swan 270B will be given away as the main prize. The supper on the evening of July 24 will be highlighted by the film "Hams World Wide" and a talk by ARRL Delta Division Director, Mr. Max Arnold W4WHN.

For more information, tickets, or reservations, contact the Jackson Amateur Radio Club, Box 8371, Jackson MS 39204.

MILWAUKEE

The South Milwaukee Amateur Radio Club will hold it's second annual Southeastern Wisconsin Swapfest on July 17 at Shephard Park (VFW Post 434), 9327 South Shephard Ave., Oak Creek, Wisconsin. The activities will start at 7:00 a.m. and run until 5:00 p.m. or later. There is plenty of parking and a picnic area, as well as hold and cold sandwiches and liquid refreshments available on the grounds. Admission is $1, so bring your friends and whatever goodies you have to swap or sell. For more information, write to A.R.S. WB9EQA, 1900 West Kimberly Ave., Milwaukee WI 53221.

PENNSYLVANIA

The Two Rivers Amateur Radio Club will hold its annual hamfest July 18 at the Balcon Hotel grounds in McKeesport located 15 miles east of Pittsburgh. For information write Charles E. Thomas WA3MWM, 7022 Blackhawk, Pittsburgh PA 15218.

CALGARY STAMPEDE CONTACT

The Calgary Amateur Radio Association announces that it will operate station VE6NQ from the grounds of the Calgary Stampede from July 8–17, 1971 inclusive. The schedule calls for operation from 1900 to 0500 GMT daily. Prevailing band conditions will dictate which frequencies shall be used at any time. Operating frequencies will be near or at 3.560, 3.780, 3.825, 3.900, 3.943, 7.060, 7.190, 7.225, 7.270, 14.060, 14.150, 14.250, 14.336, 21.060, 21.240, 21.300, 28.060, 28.500, 28.600 MHz. Several transmitters will operate simultaneously. Net call-ins will be accommodated.

A special QSL card will be sent to all contacts. A QSO with VE6NQ during this period will count as two Calgary contacts for those amateurs working for their Calgary Stampede Certificate.

The theme of the Calgary Exhibition and Stampede this year is "Sports and Recreational Activities." CARA will have a prominent, "walk-through" working exhibit, displaying all modes of amateur radio communication. Special emphasis will be placed on the display of low-cost equipment within the reach of those with limited means.

Calgary Amateur Radio Association, Box 592, Calgary 2, Alberta.

NORTHERN GERMANY

On May 15th/16th, 1971, the 14th VHF Ham Convention in Northern Germany will be held in Klein Rhueden/Harz. This traditional meeting is organized by District Niedersachsen of Deutscher Amateur Radio Club (DARC) and directed by DJ1WM. Klein Rhueden is situated in the pretty landscape of the nearby Harz Mountains. It is easily within reach of the Hamburg–Frankfurt autobahn through exit "Klein Rhueden" (about 35 miles south of Hannover).

Main topics of the VHF meeting are a contest for mobile stations (145 MHz and 432 MHz) In all kinds of and FLEA MARKET on Sunday May 23, 1971. The flea market will start at 10:00 AM (please bring tables) and the auction will start at 2:00 PM. There will be refreshments and recreation for all. The address is: Henniker N.H., Keyser Pond Cottages, off Rtes 202 & 9, near junction of Route 127 (near the Hopkinton Town Line).

BURBANK

The Lockheed Amateur Radio Club sponsors the only annual ham show in the Los Angeles area. These shows feature displays of the latest ham equipment by manufacturers and distributors plus technical presentations by the best available speakers.

These shows are open to all amateurs and prospective hams. A data sheet is available to those who request one from 2814 Empire Ave., Burbank CA 91504.

SPECIAL PREFIX OPERATION–KQØNEB

The Lincoln, Nebraska Amateur Radio Club has revealed plans to operate a special events, special prefix amateur radio station in connection with the 1971 Nebraska State Fair in Lincoln. Using the call KQØNEB, operations will commence at 2100 GMT September 1, 1971 and will be continuous 24 hours a day through 0500 GMT September 9, 1971. Transmitters will be on 10, 15, 20, 40 and 80 meters, both CW and SSB.

DX contacts will automatically be QSLed via bureaus. Stateside contacts must send cards with SASE to WØYOY, Box 5006, Lincoln, Nebraska 68505. As with past operations of the club, a special QSL card will be used.

DELAWARE

The Delaware Amateur Radio Association is planning a hamfest on June 6, 1971, at the Prairie Creek Reservoir shelter house on the northeast corner of the lake. There will be an auction, a flea market, and free coffee for everyone. Prizes given away, including a Temp I with power supply. Box 610, Muncie, Indiana.

NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

For Sale?

The word is being whispered around that Green wants to sell 73 because business is bad. Business is undoubtedly bad for those originating the whispers, but it isn't all that bad here at 73.

What does a ham magazine earn? What are the expenses? What profits are possible? Our figures aren't complete for 1970, but we do have the 1971 first-quarter results, which are probably of more interest anyway.

The income for 73 is derived from advertising, circulation and book sales. Roughly speaking we figure about $15,000 for advertising, $15,000 for circulation and $10,000 for books per month. This rounds out to about $500,000 a year gross income.

Our expenses cover printing bills for 73, which is printed in Wisconsin, plus all of the salaries and overhead in Peterborough, payments for articles, drafting of diagrams, etc. We print most of our books here at 73 where we have an extensive printing plant with three fast offset presses, going up to 22" width, plus a complete book bindery. We also set all type here for 73 as well as our books, have our own complete art department to make up finished pages, and a darkroom for making offset negatives. This is all accomplished by a staff of fourteen very busy people.

Visitors almost always wonder why, considering the printing plant we have right here, we don't print 73. It is one thing to print 5,000 or 10,000 books and quite another to print 75,000 copies of a magazine. We can afford to take a month or two on books, but 73 must be out in just a twenty years now and I'd like to see an end ahead somewhere.

What have I to offer? Well, if someone wanted to take over the magazine as it is, it isn't a bad deal. We have the staff and the plant to provide a good income, plus a house to live in. The house is a bit crowded and the living is certainly informal, but it is one of the nicest areas in the world to live.

What is such a business worth these days? Some estimates are that it should be worth about the yearly income. Others put it at about ten times the yearly profits. In fact it is worth whatever someone is willing to pay. I'm in no rush to sell and still have to find out from a tax expert the best way to take payment so I will end up with enough to invest for retirement. Does anyone know of a good tax expert that might be able to help me with this problem?

Brou-ha-ha

The publisher of another ham magazine has, I hear, launched a circulation building attack on 73, using what appears to be self-written unsigned letters and other honest tools of his trade.

If my interpretations, giving more weight to his coverage than to his protestations of opposition to the proposed two meter emasculation, are in error, then I certainly apologize.

In fairness to our research staff I must admit that they attempted to check out the details of the matter, but found that most of the pages of the back issues of that magazine had been used in the 73 restroom.

the FM scene

by K6MVH

Dayton Hamvention

The Dayton Hamvention was a smash success this year. Of course, the Dayton thing is a smash every year – but this time, wow! Crowds were so abundant on the floor of the exhibit area that you could spend upwards of 15 minutes just getting from one end of the building to the other.

The biggest attraction of the day was FM, and I doubt that anyone would deny that. Pocket FM transceivers were part of the uniform of the day. It was certainly a strange sight, all those whips jutting up above the crowds on the floor. Manufacturers of gear for 2m FM reported unprecedented sales volume; and distributors were taking orders well after they'd sold every sample they had brought along.

At the 73 booth, sales of FM books exceeded sales of all other publications by a factor of three to one, with our just published *Best of FM*, an anthology of selected articles from the more recent issues of FM Journal, leading the field by a comfortable margin.

Mike Van Den Branden and Art Housholder were there to tell about their new planned magazine (to be called . . . *rpt*). Mike was publisher of the now-defunct FM Bulletin, and Art is manager of Spectronics Inc., of Oak Park, Illinois, an FM dealer. The two say their new magazine should be published some time in July.

One of the busiest booths at the Hamvention was Regency's. The Regency boys had on display a rig that represents a new concept in FM transceivers. It was a rig built around a drastically improved version of the presses the button under the indicator lamp. As long as that button is down, the rig won't scan and he can transmit on that locked-in channel. When the QSO is finished, another button starts the scan sequence again. The whole thing is very impressive. One of the interesting features of this scanner that is not found on other units is its system of maintaining scanning speed regardless of the number of locked-out channels. On a conventional scanner, you can lock out as many channels as you like so that the frequencies are bypassed in the scanning process, but most receivers still use up the same amount of time to sample each channel, locked out or not. The new Regency transceiver, though, has a system that not only cuts out a locked-out channel but eliminates the sampling time of the locked-out channels as well. This system precludes the possibility of missing the first word in a transmission because the scanner is "someplace else."

Rent-A-Mobile

I really got the chance to get around in style in Dayton. The local repeater operates .34/.76, and both my Handie-Talkies are set up for .34/.94 and .94 simplex. So I was worried that I couldn't talk to any of the local repeater crowd. But things really worked out for me. I had tested a Regency transceiver several months earlier and applied too much dc input voltage, thereby blowing one of the transistors. Fortunately, the Regency people fixed the unit and returned it to me at the convention. Since the multichannel Regency HR-2 had .34/.76 as well as other standard the transceiver in the car I had rented from National.

But of course National Car Rental does not equip its fleet with two-way antennas or handy sources of battery voltage. The situation was still not hopeless, though. John Altmeier, from New-Tronics, said he had just the antenna I'd need for use in a rented car. He left his booth and dug up a brand new 2m gain antenna that mounts on the trunk without leaving any marks.

In only a few short minutes, Steve Holden installed the rig and antenna. And so I was mobile. The HR-2 worked extremely well through the repeater and the Hustler antenna from New-Tronics did a fantastic job.

Bumper Stickers

In a recent editorial I mentioned that 73 had printed a few hundred "ministickers" for car bumpers with the words, "Listening 94," "Listening 76," etc., for all the 2m FM channels. I also commented that these were available on a no-charge basis in exchange for self-addressed stamped envelopes. Well, the deluge of mail was overwhelming. We had to reprint the banners twice, and eventually we ran out of peel-off-back fluorescent paper – but still the orders kept coming in. Finally, we stopped fooling around and ordered a large quantity of new stock, reprinted the stickers to insure that we wouldn't be running out any time soon, and stockpiled the strips for immediate delivery. So if you got left out, or if you would like to advertise the channel you're monitoring, drop a note to me (including SASE), and I'll mail you a couple. (Be sure to indicate what channel you want.) This second batch of stickers differs slightly from the first: The letters themselves are a little larger than those of the first run, and a small ad for 73 is included across the bottom. The stickers now say:

few days. This means that nothing less than a high speed web offset press is suited for the job, with fully automatic folding, binding and mailing machinery attached. Even with all three of our presses running day and night it would probably take about three months to print an issue of the magazine.

How is 73 doing in comparison to the other ham magazines? We do have a considerable advantage by virtue of some two years of selling 73 readers on the fun of FM. This is the most rapidly growing aspect of the hobby and advertisers have found that ads in 73 are the key to large sales volume since the 73 readers have been presold on FM. It is interesting that we have not had to resort to cut-rate subscriptions and super cut-rate advertising to keep going. To the contrary, our profit picture for 1971 is most encouraging.

Our first quarter report shows a net profit (before taxes) of $12,231.85. That is close to the expected 10% profit we consider acceptable, being about $4000 per month on about $40,000 sales.

We have several excellent books in the works which should bring up our second quarter income (and profits), plus of course the steady increase in interest in FM which should reflect in even more FM advertising in 73.

Why, then, am I talking about retirement? There are, of course, many reasons. I'd like not to be tied down so firmly . . . to be able to go on some DXpeditions without having to worry about the magazine . . . to be able to travel . . . to write some travel books . . . to write articles for other magazines . . . to move around and live where I want when I want . . . to ham all I want . . . some freedom.

Running 73 is fun. It is a lot of fun. But it is restrictive too. The monthly deadline is inexorable and is a basic fact of life that is sometimes oppressive. Eventually I want to get out from under. I've been at this editing and publishing business for

There was most certainly no intent to discredit the publisher of the other magainze, since we suspect that he is entirely capable of taking care of that without any help from us.

popular Regency scanner. The receiver section scans up to eight channels, and locks onto whichever channel is active. If the operator wants to communicate on that frequency, he just

frequencies, I tried to find a way to get a good portable power source so that I could use the rig during the Hamvention. Steve Holden (WA8RZL) suggested that I mount

Repeater Atlas

It's very difficult to keep apace editorially with the flood of repeaters making the scene across the continent. More than 150 additions have been noted since the April repeater directory was published, and new repeaters are appearing every day. The changes are happening at so swift a rate that 73 decided to hold off publication of the FM Repeater Atlas until things stabilize. We'd really like to make the Atlas into an accurate, up-to-date, and handy reference work that can be used by mobile ops and transient FM'ers. So, what we're doing is having the repeater photos and coverage maps printed now. The directory portion will be printed last. In all, it looks like the Atlas will be available for delivery about six weeks from the date this issue hits the stands. If your repeater has not been included in the Atlas, please make it a point to clue us in immediately. We want *no* repeater to be omitted from the Repeater Atlas – we're determined to make this volume our most comprehensive listing ever.

LETTERS

advised by my lawyers that
ou goons don't ever proofr
I insist that you print ev
should be boiled in oil ov

An All-New League

In regard to *The Institute?* (April 71): If you revived it you would gain more support than it did on its initial venture. After reading the article I would be willing to pay any necessary dues, as it would be going to good causes; i.e. legal funds, lobbying, etc. If you remuster, I would gladly give up my ARRL membership.

Scott Liebling WA3OXG
5616 Beacon St.
Pittsburgh PA 15217

I picked up 4 issues of your 73 radio magazine and sure opened my eyes as to what is going on at the ARRL (I have been a member since 1939). What Mr. Wayne Green writes sure makes a lot of sense.

John Sauritch W3RWA
829 Prospect Ave.
Charleroi PA

If Wayne would represent us in Washington, D.C. I would be willing to kick in $1 per month to support a *working League.*

William Tegtmeyer WB8AMQ
RD 3, Box 182
Wakeman OH 44889

I support Wayne for League manager, too.

Lyle C. Henry K9DKA
3365 Duluth
Sturgeon Bay WI 54235

Exams

I now hold a General class amateur license. I plan to file for the Extra class exam. If I pass only the Advanced part of the total exam, do I get an Advanced license?

Fred Martin
202 Kenny St.
Fayetteville NY 13066

You bet.

As a new member in the ham fraternity, I must admit that as magazines go, 73 is the best around. Your many articles on FM were responsible for finally giving me the push needed for my license, and I especially enjoyed the April issue on repeaters, which seem to be popping up on every mountaintop; however, after looking at your April directory, I'm slightly confused.

You list W1ABI on Mt. Killington as 34/94 with 2400 Hz tone burst under Vermont, New Hampshire, and Mass. Under New York, though, it's listed as 34/94 with 2100 Hz tone.

WA1KFX on Mt. Snow is listed with no 34/94 capability except under New Hampshire.

W1KOO on Mt. Mansfield has a 34/94 channel with 2400 Hz burst under most of the New England states, but as Mt. Mansfield and Mt. Killington are rather close to each other, shouldn't a 2400 Hz tone on 34 trip both repeaters even though only one is wanted?

Ken Fowler WA1NSR/O
PSC-1 Box 2215
Ent AFB CO 80914

According to information from Gordon Pugh (owner of both repeaters), WA1KFX is .31/.88, with tone provisions for .31/.91 and .31/.94. WA1ABI uses 2.4 kHz audio for triggering the .94 output from either .28 or .34. The NY listing was incorrect. Repeater owners and users should keep 73 informed of all statistical changes or errors in listing.

Small Print & Sidewise Pages

I would like to voice a sincere complaint about 73 magazine. I cannot understand why you persist in the small print and sideways pages that you have undertaken in the past several issues! I used to enjoy reading the letters and other trivia – but now?? I note that you printed one such complaint in the March issue. I wonder how many others you get . . .

I can understand you get more on a page so why don't you microfilm the whole magazine and rent us all readers.

Bob Carlson K6VOI
Member of the "ROYAL SOCIETY OF COSMOPHONISTS"
1309 E. Elgenia
W. Covina CA 91790

We're studying the feasibility of reader rental now.

In answer to your sincere complaint about the sideways pages of small print we would like to explain the rationale behind this curious change in 73. Ever since its start 73 has been known for its quantity and quality of technical and construction articles. Indeed, few amateurs who are interested in the technical side of the hobby are not regular readers of 73. Unfortunately this still left a lot of nontechnical amateurs with no sound reason for reading 73. In order to provide more coverage of the news and events side of the hobby the news pages were inaugurated. After a little experimentation it seemed that the pages looked more like a newspaper when printed sidewise. This also had the benefit of permitting more of the pages to be used for printing than normal. The use of small type allowed even more material per page, thus enabling us to cut back very little on technical articles to make room for the new feature.

The newspages do seem to be providing interest to nontechnically inclined amateurs and may be worth their weight to all concerned. More subscribers mean more ads and that, in turn, means a bigger magazine overall. Bear with us . . . and let us know your reactions.

Here is my renewal for another two years. I enjoy 73 more than brand X, Y, or Z, and I take all of them. Some of the editorial comments are redundant, especially Dave Mann; but I even get a kick out of that. Don't like having to turn the mag sideways for hot news.

Clayton Dewey NØUMN, K8CKD
404½ S. Washington Ave.
Ludington MI 49431

Better redundant than dundant.

Cont. on News Page Four

Cont. from News Page Three

I just wanted to tell you that your "sideways" letters, news page, etc. doesn't bother me one bit. I *like* it, and I like everything you do. Keep it up.

Ira Lefkowitz WN1NMI
15 Carpenter Lane
Bloomfield CT 06002

Run That By Again

Too late for your repeater issue, but: .34/.94, 170 ft tower, 1 kW, no tone access. Can switch to .76 manually.

Bob WA8PIE

Great, Bob. Now tell us the repeater call, location, and coverage area.

Old Ads

Yes, I would like to see more of the 50-year-old advertisements in future issues of 73. Maybe something like one page every other issue so that the complainers could not say they were being shoved down their throats all the time, hi.

Also, I am working on a book about old-time radio, and as you say that you have a million of the old ads, I wonder if you would care to send me some of them so I might include them in the book.

Gordon E. Hopper W1MEG
75 Kendall Ave.
Framingham MA 01701

Million is only a figure of speech.

First, let me say that after being a ham for only nine months (and receiving 73 for an identical period of time) I have become an avid reader of 73 and a firm believer in its number one position among ham magazines. Your rag is clearly superior to any and all competitors.

Second, keep the old advertisement reproductions in each issue. They are both nostalgic and interesting.

Dr. Raymond L. Read WN4RCH
1534 Marston Road
Tallahassee FL 32303

The Institute

I just laid my hands on a recent issue of CQ and a most disturbing W2AOO gets my kudos – however, how does W2AOO state that his amp should be able to be built for less than $20? I am lost. What kind of junkbox is he referring to?

I have been in the game for more than 40 years, and even as a professional, I never stocked more than 3 horiz. output tubes. And considering the tubes list for $51.90 plus tax, these 6JE6 tubes would net more than $20. Therefore I must have the wrong sort of junkbox, or something is wrong.

Joseph T. Beck K4AQT
3810 Leila Ave.
Tampa FL 33616

Do what Seymour did (letter above) and drop the author a line.

FM-FM-FM-FM

Frankly, I am so sick of nothing but FM in 73, I could puke.

Until Ken got on this FM binge I have always considered him one of the best of writers, BUT as an *Editor*, he stinks.

Kayla was at least versatile and put in a very good selection of material – a very good editor. If 73 is going to stay an FM publication please stop my subscription and refund balance of my new 3 yr sub. I paid a few months ago. I have been a ham over 41 years now and have never canceled out from any mag before. Have always enjoyed 73 over the past years.

The sideways print is lousy too, but not as bad as FM-FM-FM-FM-FM-

D. M. Burrill K7JVZ
224 13th St.
Sparks NV 89431

I am interested in anything on antennas and almost anything relating to ham radio except FM, UHF and RTTY.

Francis McCray W3BZV
Box 103
Elgin PA 16413

I enjoyed the April issue of 73, especially the material on two meters which I have never thought very much

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor. . .

OLD TOY TRAINS WANTED, pay cash or trade for Swan Cygnet 270, ac-dc, vox, immaculate. Please state numbers or lettering on train(s). Don Hilke K9CMN, 3381 So. Howell, Milwaukee WI 53207.

GET YOUR "FIRST!" Memorize, study – "1970 Test-Answers" for FCC First Class License, plus "Self-Study Ability Test." Proven. $9.95. Command, Box 26348-S, San Francisco CA 94126.

TRANSCEIVER AUTO-MOUNT, $7.95. See ad in May '70 issue 73. Arco Mfg. Co., Box 817, Grand Forks ND 58201.

Your magazine is, with the April issue, regaining the quality of early last year, which seems to have been on vacation for the last few months.

Dan Deckert WA6FQC
3630 Bentley Ave.
Los Angeles CA 90034

The April 73 is great.

Larry Waggoner

A CLEGG ZEUS with AC416 supply, Clegg Intercepter B, a 5 E 6M Beam, a 10 E 2M Beam, 2 Feed Lines RG-8, 1 Dow Key, coax Relay, 1 on and off the air light, 1 24 hour clock, an Electrovoice Mike 729. Would like to sell complete station for health reasons. Roy LaDuke K1COJ, 207 Clinton St., Concord NH 03301. 225-3900.

FOR SALE: Ht-46 Xmtr and Nc-300 Rcvr. Both in excellent condition. $280 or best offer. Dale Stuewe WA7IMI, Rt. 3, Box 405, Corvallis OR 97330.

CRYSTAL OVENS, octal for dual HC/6, 6.3 volt heater. Unused surplus, great for commercial FM mobile rigs. $1.00 each postpaid. Charter Electronics, Box 88, Gladwin MI 48624.

GALAXY FM-210: Factory Narrow-Banded, both AC and DC Power Supply, 5 watts out, Xtals for 94/94, 34/94, 34/76 with mobile mount, cables, manual. $160.00. Ed Pores WA2ZBV, 16 Dorchester Drive, Manhasset NY 11030.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland CA 94607. 451-775, area code 415.

CONSET 6M 225W amplifier $75; 2M 500W $225; 432 (7034/4X250B) $75; Bird #43 $79; Three FM-210 Xtals $5 each. W4API, Box 4095, Arlington VA 22204.

LISTING SERVICE – gear to sell? Need rig? Sellers – $1.00 lists information year. Buyers – free. SASE brings details. Listing Service, Box 1111, Benton Harbor MI 49022.

FM HAMFEST Sunday August 1, near Angola Indiana. Big prizes, free flea market, entertainment for the ladies and kids. Picnic grounds, campsites, boating, food, soft drinks available, rain or shine. Call in Freq.

SELL: Collins 32S-3, 75S-3, 516F-2 AC Supply, $950. Drake R4B, T4XB, AC-4 Power Supply, $850. Johnson 6N2 Xmtr, Eico Mod. 730 Modulator, Johnson 6N2VFO, Heath UT-1 Power Supply, $100. Clegg Zeus Mod. 331, Mod. 332 Power Supply, $75. Henry Radio 2K Final Amps #239, $375. H. H. Heard, K5IPL, 600 Main St., Arkadelphia AR 71923.

ELECTRONIC ORGAN, Full Spinet, Transistorized, two manual. SASE for particulars. Lloyd G. Hanson W9YCB, RR2. Box 52A, Angola IN 46703.

SELL: COLLINS KWM2, Ser. #1121 with PM-2 AC & 516E1-DC PS, asking $695.00. John Fearon, 3384 Peachtree Rd., N.E., Suite 705, Atlanta GA 30326. Home Phone 237-1261. W4WKP.

YOUR CALL LETTERS. Two sets, for windshield and rear glass. Smart white letters with red outline. Easily installed pressure sensitive decals. $1.00, postage paid, anywhere. Satisfaction guaranteed. Lake Jordan Artists, Slapout AL 36092.

TECH MANUALS. . . $6.50 each: R-390/URR, TS-186D/UP, BC-639A, USM-26, CV-591A/URR, BC-348JNQ, URM-25D, SP-600JX, UPM-45, UPN-12, TS-497B/URR. Hundreds more. S. Consalvo, 4905 Roanne Drive, Washington DC 20021.

HAMFESTERS 37th HAMFEST AND PICNIC Sunday, August 8, 1971, Santa Fe Park, 91st and Wolf Road, Willow Springs, Illinois, Southwest of Chicago. Exhibits for QM's and XYL's. Famous Swappers Row. Information and Tickets, Joseph W. Poradyla WA9IWU, 5701 S. California Ave., Chicago IL 60629.

DRAKE 2B, 2BQ, 2AC calibrator, excellent, $190. HT-37 transmitter $165. HT-41 linear amplifier $175. All, $500. All original owner with manuals. Gerry WB2FJX (212) 641-4573.

editorial. In it, the author labeled you as an out-and-out thief! What I am referring to is where the publisher of CQ said that you collected money for your IoAR, but never started the organization and kept the money. Whether this is true or not is what I would like to know. I would be very grateful if you would tell me the truth about the above. I am a concerned 14-year-old Novice.

Robert Davidson WN8IPB
63 Paw Paw Lake Dr.
Chagrin Falls OH 44022

As you get older you will find that adults are not too hesitant to "imply" a scandal or similiar situation if it suits their purpose. I think adults have become very blasé in regard to smears, as yours is the only letter with a request for enlightenment . . . for the thousands of other readers, it seems no one cares. This is refreshing and a marvelous reminder of what your generation can and will accomplish.

If you've the April issue of 73 Magazine, please turn to page three for Wayne's editorial entitled "The Institute" . . . all your answers are there.

Horizontal-Output Linear

There was an article in your March issue, by W2AOO, on the construction of a "Horizontal Output Linear." Due to my limited knowledge, I wrote to Mr. MacDowell requesting some help. Words cannot express how encouraging and helpful Mr. MacDowell has been. It's very hard, this day and age, to find someone who will take the time and trouble to help someone just getting started.

As long as a magazine has people of this caliber writing for them I don't see how it can do anything but succeed. Congratulations to you for a fine magazine and thanks to W2AOO for his help.

Verlon Brewer WN9FQG
Seymour IN

A very fine article, and thanks for inserting this in the issue of 73. about. Anyway I sent off a check to one of your regular advertisers and shall get into 2m FM without going broke.

Louis O. Williams
1613 Cambridge Ave.
Floosmoore IL 60422

Your April issue was outstanding. I am a newly converted FM addict and I really got a lot out of the articles in that issue.

I am looking forward to finishing my school here and getting back to New England to try some of the repeaters there. I have really enjoyed using our local repeater (K5TYP) and I hope all FM'ers are as friendly as the bunch around here.

S/Sgt Rick Brown WA9FC G/1
CMR No. 4 Box 20016
Keesler AFB MS 39534

Fantastic April FM issue –

Gary Davis WB2PSS

Keep up the good work with FM. Nice mag – best in business.

Norm Zoltack WA3RGS
Bethlehem PA

Keep up the very good job with 73 . . . I operate .94 and .76 FM.

Stan Head W4BBD/8
Columbus OH

The "hot" subject at the present time in this area, and most others, is FM and your publication seems to be right on target with timely articles.

M. B. Farmer
Electronic Exchange Co.
Metairie LA 70005

Congratulations to you and 73 for the extremely interesting and comprehensive repeater directory contained in theApril 1971 issue.

Jack D. Forbing K9LSB
1416 Lakewood Dr.
Fort Wayne IN 46809

Doing an excellent job on FM in 73 Mag.

B. Walten WB4GZG

I enjoy your 73 Magazine. Keep up the good work. I'm glad there is finally a mag with some articles on FM, etc.

Jere D. Bruning, WAØUQA
White Cloud KS 66094

We enjoy your magazine very much, especially the FM articles. Keep up the good work.

Weldon Glenn WB5AEP
Route 1
Levelland TX 79336

Keep up the good work – FM is the most fun I have had in years.

David Dickson WA9JRA

Thanks in advance, and I think your magazine is tops all the way around. I operate FM on .94 and .73.

Les Hodges WB8ETP
2611 Pleasant Grove Rd.
Lansing MI 48910

Congratulations on your very fine issue covering the FM mode of communications. A continual updating of the repeater directory will be most helpful to all of us in traveling. Keep up the good work!

Robert T. Green K8JXE
5764 Heather Hollow
Dayton OH 45415

Tone Standardization

Our club supports proposal RM 1725 with the reservation that FM editors attempt to standardize tone frequencies as they have standardized input/output frequencies in order to provide repeaters that help serve all interested amateurs rather than limit repeater usage to a chosen few.

Kenneth H. Brockel WA2FPB
Secretary, ETSNJ
213 Cotter Ave.
Neptune NJ 07753

Tone frequency standards are 1650, 1800, 1950, 2100, 2250, 2400, 2550, 2700, 2850 Hz.

. . . Ken

MORE LETTERS

Girls

Let's have more covers like the April issue. Wow!!!

Bob Mackey WN9ERZ

Getting Started

I suspect the column by Fred Mocking "Getting started in Radio" was some sort of substitute (probably intended for Radio Today) but I want to say I thought it was great.

I am an "appliance operator" and I would like to see this column become a regular feature.

Mike Head WA5TWM

It is to be a regular feature.

Shame shame

Out of curiousity, how many hams wrote in asking how come your April cover girl was using the TR-22 without a ticket? Let's not leave openings like that!

S. D. Henderson K1VOL
595 Main St.
Cromwell CT 06416

You're the only one.

Is that an old J-38 key in the lower left-hand corner of the center foldout of the April issue of "Playboy"?

Alan Bloom WA3JSU/1
200 Washington St.
Middletown CT 06457

Who looks in the corner?

Much Ado About Nothing?

Come on now! UHF FM is great but it certainly shouldn't be taken all out of proportion as your magazine seems to be portraying it. It doesn't take the place of sex or of the lower frequency mainstay of amateur communications. I find it difficult to locate a purpose for this type of communication in amateur circles. To

I have subscribed to your magazine for quite a long period of time. Lately I have become dissatisfied with 73. In fact for the past year it seems that the magazine has been covering the most uninteresting subjects. Several issues including the current April 1971 issue deal with FM repeaters, frequencies, etc., and I realize you probably have a few screwballs who like that sort of ham radio. Personally, I find your magazine boring, and since I have no love for FM, repeaters, and other VHF and UHF type of radio, I now feel that when my subscription runs out, that I most certainly *shall NOT renew.*

I have felt that your editorial policy has been very good, and I agree with all your comments about the ARRL and its lousy attitude toward the amateur – especially the incentive license matter.

Truman P. Oliver W8FWT
12752 Chatham Ave.
Detroit MI 48223

Sorry to lose you, but magazines have a responsibility to provide more than the average amount of information on new developments such as FM. Keep in mind too that FM is the biggest new development in amateur radio in over ten years. Even so, few issues of 73 have more than one or two FM articles,. . . it just looks like a lot because the other ham magazines print so very little about FM.

I am an avid fan and subscriber to the 73 magazine but the April issue made me sit back and wonder why I am a subscriber. I used to enjoy the articles but lately all that is in it is – 2m FM. In this issue some 120 of the 144 pages are devoted to FM. That is fine for the amateurs who are devoted to FM but I am not, and I think that there are many more hams who aren't. Don't take me wrong – I

Great Mag. Enjoy the editorials and the FM articles and reviews. Would like to see some on conversion of some of the more recent commercial and military FM gear.

Bob Brunkow K7NHE
15112 S. E. 44th St.
Bellevue WA 98004

So would we.

Enjoy your magazine; mostly VHF projects and FM.

John Kurtinecz

73 for the Blind

My husband is blind and would like to know if 73 Magazine is offered anywhere recorded for the blind or available in large print? If so, where and how may we obtain them?

110 Polaris St.
Cocoa FL 32922

73 is available to blind and handicapped individuals. Write Science for the Blind, 221 Rock Hill Rd, Bala Cynwyd, PA 19440.

Gift Idea

When the recent issue of 73 arrived in the mail, it solved a great problem for me. A friend of mine recently invited me to his "over-the-hill" birthday party. (He'll be 30) I didn't know what to give him until I remembered that he had expressed interest in ham radio on several occasions. So here is the price of his first year's subscription. For only 50¢ a month he can enjoy 73 just as I do, and who knows, he just might be a subscriber from now on.

I think this is a great gift idea and wish I had done it for others before.

With all the letters to the editor praising 73, it is obvious that your readers support you and your efforts. I do too.

I'm sure all your subscribers have a friend who is a recent ham or a potential ham and who would appreciate a gift subscription. If each sub-

money is entered into the LA5LG Memorial Fund, which is used to help handicapped individuals become hams.

This all started in 1966 when a young man from Oslo sent a letter to NRRL HQ containing a very simple question: "What shall I do to become a radio amateur?" The man was lame from the neck down after a diving accident. Obviously, he could not meet the CW requirements on the transmit side. A special agreement was obtained, however, by the president of NRRL. When he and the other members of HQ saw what it meant to the young man to be able to talk to others all over the world without being hampered by his handicap, they realized that many others may need help the same way without knowing how to set about it.

The plans for a fund and an organization to help them had hardly been initiated when LA5LG, then president, died. LA1TE, elected in his place, hurried to work, and soon the LA5LG memorial fund was established. A collection was set up among Norwegian amateurs to finance the purchase of rigs, and a special license was granted by the authorities.

It was a fantastic success, but the money available proved insufficient by a long way. Various organizations were asked to help, mainly Lions and Rotary, and both were positive. But it still was not enough.

During the summer of 1968 hams of Sweden and Norway occupied the independent territory of Morokulien, situated around the Norwegian–Swedish peace monument.

A special call (LG5) was issued, and operation, plus sale of QSLs (3 IRC) and letters of citizenship commenced. Since then the fund has been gaining steadily.

The real boost came last spring, when a TV program was sent over the national net, showing several cases and what amateur radio meant to them.

After the program a net started

About a hundred amateurs have started up in this way, and following them from the first day on the air, when they hardly dare speak at all – some hardly *can* speak, after years in institutions with only busy nurses and even busier doctors to talk to – it is gratifying to see them becoming more and more talkative, more and more interested in the world beyond their beds and wheelchairs, start learning code and thoery, then finally passing the full test.

LA8PM Per Marienborg
Stovnervn. 17
Hoeybraaten
Norway

Thanks

I would like to take this opportunity to thank you for furnishing 73 to the Army MARS stations in Vietnam (forwarded to us by Alex A9EU). 73 has not been available in the PX bookstores, so it is a rare privilege to receive a current issue regularly.

Vernon W. Ireland
SFC,E-7
NCOIC, AB8USA
Radio Company LBN
APO S.F. 96491

ARRL

I have been a Wayne Green supporter and agreed in his criticism of ARRL. I feel that he's done amateur radio a great service by opposing the dictatorship of ARRL.

O. A. Wise KØMVR
Corunna IN 46730

Net List

Would think it a good idea to publish a list of active nets on various bands, say once a year. A suggestion by you would elicit contributions, and it might well be a useful service in traffic handling.

J. F. Weatherly K1ZYG

me it seems as thrilling as getting a new telephone installed that is tied to a 100 party line. Maybe the thrill is in trying to get a word in edgewise or of listening to everyone else. TTime-sharing is great for computers but humans should be able to talk as long as someone else is willing to listen to them.

I can travel anywhere in the U.S. with my 10–80m mobile transceiver and nearly guarantee communications any hour of the night or day whether I am in Nevada or the middle of Pennsylvania. If the going gets rough on SSB, I switch over to CW. I more than suspect that a cross country drive with UHF FM will generate a minimal of QSOs and lots of frustration.

Let's recognize UHF FM for what it is – a darn good technology for local, noise free, communications, and a good opportunity for manufacturers to start making money again. What the percentage of need is for this kind of amateur service remains to be seen.

Herman Lukoff W3HTF
506 Dreshertown Rd.
Fort Washington PA 19034

The key to UHF FM superiority is in its repeatable performance reliability. True, you wouldn't make a lot of UHF contacts on a cross country jaunt – but that doesn't mean there isn't a lot of action on 450 MHz. Most of the UHF repeaters are "closed" to casual use of transients and are set up for the convenience of the local amateurs.

I am not too interested in FM. I tried it a few years ago and found it too much like CB. I sold both rigs and haven't tried it since. I decided recently to drop my subscription to CQ. I reviewed the issues for the past year and thought it a waste of money. Compared with the "good old days" of 1957–59 there is nothing in them. Except for too much FM, yours is tops.

Russ Lorentz W9HLN
Ft. Wayne IN 46815

FM has improved since the old days. Try it again and be astonished.

think it is fine that many amateurs are interested enough in the higher bands to keep them alive, but there are still a lot of us who like articles on other phases of amateur radio and would like to read about them in 73 magazine. So come on . . . let's give at least half to other phases of the spectrum.

Al Fudge
19-C Lyellwood Pkway.
Rochester NY 14606

You are probably right, we have been emphasizing FM a lot recently. Watch the next few issues and see how you think it is going. Keep in mind that one of the reasons that we have been talking FM so much is that it is a lot of fun, doesn't cost much to get on the air, and represents a new and very valuable growth of the hobby. How else can you have that much fun for a couple big ones in amateur radio? The gang using WA2UWQ in Rochester will welcome you to their repeater . . . give it a try.

FM FOREVER!

Have been enjoying FM since 73 turned me on to it.

E. Falhof K1RVR
VP, Middlesex ARC

Keep up the FM coverage! The magazine looks better all the time

Don KH6GKV/WA1UCR

Your mag is tops and the lads in this area are climbing on the FM bandwagon! The April issue far exceeds all former issues!

C. C. Foster VE1AMF
113 MacBeath Ave.
Moncton N.B. Canada

Enjoy reading the FM Scene (K6MVH).

Bud Link W1EKE/S
5911 Inwood No. 4
Houston TX 77027

Keep up the FM articles! 73 is a great mag.

Rick Brown WAØZQX-FM

scriber gave only one gift subscription it might put 73 in the black.

Glenn Commons WA9ZGJ
5012 East 67th St.
Indianapolis IN

It might indeed!

Turncoat!

I feel it my duty to inform you that there is an enemy in your midst. The evidence can be clearly seen on Page 25 of your April issue under the heading, "War On Poverty."

Take note of certain subtle, but degrading statements cleverly worked into the copy. For example, the statement, "You will save tremendously on the highly overpriced individual=copy cost of $1."

Since when is one lousy dollar overpricing so bountiful a wealth of technical knowledge and ham news as is contained in that portable horn of plenty known as 73 magazine?

Next, your renegade has dared to imply that subscribing to the beneficent generosity of your publication is an act of charity to you when, in fact, the gain is so far outweighing the cost that it should be considered as taxable income to the subscriber. The fact that it isn't is what should be stressed.

Now, I don't question your claim to be running in the red, since you are, out of the extreme goodness of your heart, giving so much and asking so little for it, but so beneficent a philanthropist ought certainly be on the alert for enemies from within!

Bill Hood W2FEZ
116 West Park St.
Albion NY 14411

Who can argue against logic like that?

Citizenship for Fun

Honorary citizenship certificates are available for Morokulien (LG5). These honorary citizenship awards are usually forwarded on request, if the request contains $4 or more. The spontaneously on 80, discussing the show. It grew steadily, and soon about 100 hams were in, while several hundred were listening without checking in.

The next morning several people started working on their friends while the impressions were still fresh.

Expeditions set out for sports centers (this happened during the Easter holiday) equipped with megaphones and walkie-talkies to sell letters.

And on it went, after a while letters valuing more than 100,000 Kr were sold. Also, during last summer QSO nr 10,000 was worked from LG5LG in Morokulien (the name is made up of the words for "fun" in Norwegian and Swedish).

The main problem now is to reach the interested handicapped, and to train them properly.

All districts have a representative whose job it is to forward applications for stations, train the operators, make necessary alterations on the rigs so that those with serious physical defects can use them.

Sounds like a good idea. We'll publish a list of active nets if a sufficient number report in to us on a monthly basis. Any takers?

OT AMATEUR DIES

C. Kendall Morse, holder of amateur calls K1RYI and K4DCR, died March 2 at the Manatee Memorial Hospital in Bradenton, Florida.

He was born in South Newfane, Vt., the son of the late Judge John E. Morse and Emma (Chase) Morse. He married the former Jo Ann Tambasco of Flushing, NY, on Feb. 9, 1947.

He was the owner of Video Village in Brattleboro, Vt., until May 1964 when it became necessary for him to give up his business due to ill health.

SPECIAL CALL AND PREFIX

KCØKC will be heard on all bands for the period July 1st 1971 through July 5th 1971 GMT. Members of the Mobile Amateur Radio Awards Club Inc. (MARAC) and the Independent County Hunters Nets meeting in Kansas City thru these dates will man the station around the clock.

KCØKC will be on 10, 15, and 20 meters beginning when the band opens in Kansas City around 1300 GMT until the band closes late in the evening. Activity on 40 and 80 meters will probably begin around 2200 hours GMT until 1300 GMT the following day. However, activity will generally be on any band at any time that band is open. Activity is planned around the following frequencies:

BAND	CW	PHONE (1)	PHONE (2)
80 Meters	3550	3880	3910
40 "	7050	7205	7260
20 "	14050	14205	14285
15 "	21050	21280	21360
10 "	18050	18600	

NOTES

(1) Several times each hour operator will announce and listen 5 or 10 kHz below the bottom of the U.S. phone band for DX stations.

(2) If "pileups" develop operator may listen off his transmitting frequency.

LOG ALL CONTACTS IN GMTime.

For special QSL send SASE or 2IRCs to KcØKC, Box 753, Shawnee Mission KS 66201.

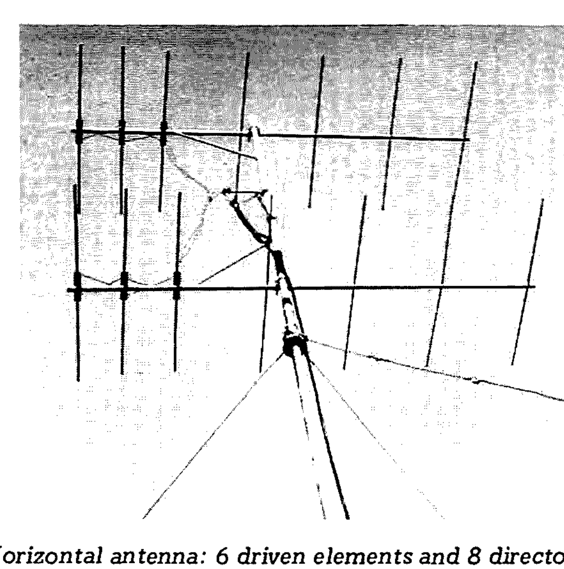
Frank C. Jones W6AJF
850 Donner Ave.
Sonoma CA 95476

DRIVEN VERSUS PARASITIC ANTENNA ELEMENTS ON TWO METERS

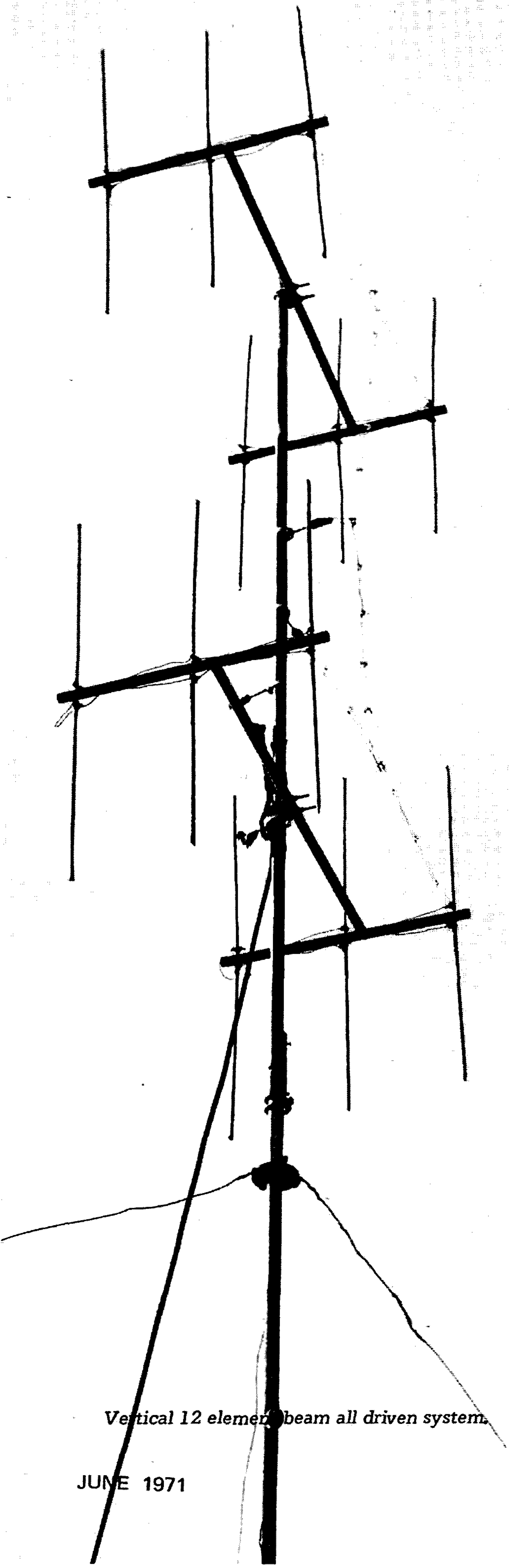
As an incurable antenna experimenter with 50 years of experience, it seemed that I had to compare all driven-element antennas with yagis. The results probably aren't too accurate since the work had to be done on the roof of my radio shack. The acre of ground here has long since become a jungle of trees and shrubs so the only space left is on a rooftop and even that has beams around it for 50, 144, 220, 432 and 1296 MHz on separate TV push-up masts.

The test results over a period of about a year have led to the designs shown in the two photographs of a vertical all-driven 12-element beam and a combination beam for horizontal polarization. The latter is interesting in that it is somewhat similar to a Swan beam design, and I used some of his element insulators in the centers of the driven elements. The parasitic directors were part of an old 2-meter beam joined to the driven-element booms by hardwood dowels and an aluminum sleeve between the front driven element and the first director on each boom.

This 14-element beam gave about the same forward gain as a 16-element curtain with slightly extended elements and spacings. The curtain beam of this design should give about 14 dB gain over a dipole; but due to aging and oxidation in this antenna, the gain figure may have deteriorated by a couple of decibels over a period of several years of use. I live about 10 miles north of San Francisco bay and 30 or 40



Horizontal antenna: 6 driven elements and 8 directors


Vertical 12 element beam all driven system.

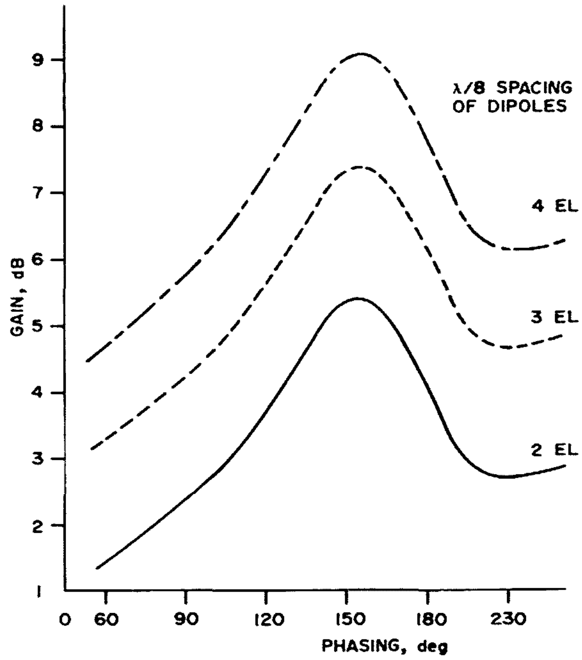


Fig. 1. Performance-vs-phasing curves for various multielement beams.

miles east of the Pacific ocean, so occasional fog conditions cause a little salt problem with aluminum tubing.

The 14-element horizontal beam in one photograph had slightly sharper forward lobe and smaller back lobe as compared to the curtain 16-element beam. Only the horizontal plane of radiation could be compared using a third test antenna feeding a receiver with a calibrated S-meter and 10 and 20 dB attenuator pads in the receiver input line.

The test antenna was not equidistant from the two antennas being tested, so only a few readings were made in comparing the two antennas. Many nights of listening on the 2m band more than confirmed the test results, since an added factor was present. Strong "power" buzz noises – mostly from electrical machinery, automobile ignition, and neon tube signals – were mainly from a direction to the rear of the two antennas. This meant less background noise from the "power" buzzes when using the antenna with the smaller back lobe.

Long yagi antennas of standard design usually have a better front-to-back ratio than curtains, but they often have less forward gain. However, even with a little less forward gain, the added benefit of less

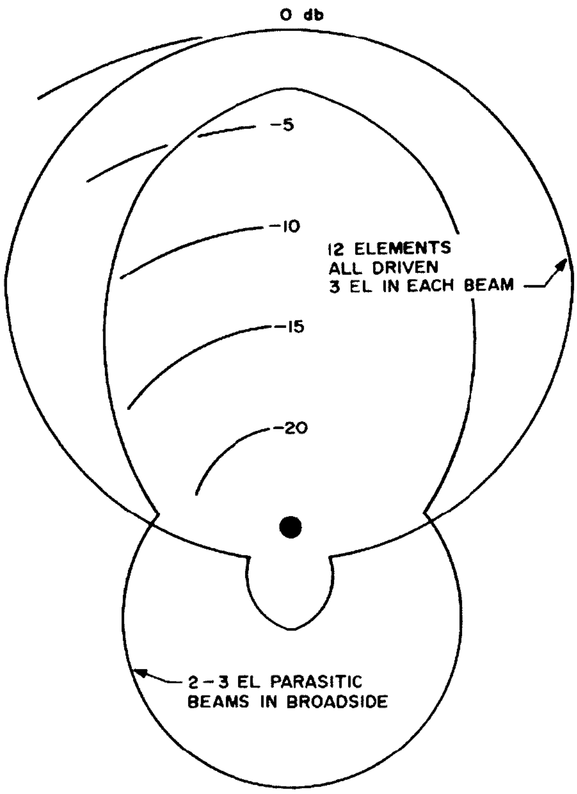


Fig. 2. Antenna pattern and gain comparisons.

QRM or QRN often makes a yagi beam give superior reception but not transmission.

A single yagi beam consists of a parasitic reflector, driven dipole, and one or more parasitic directors. All parasitic elements are excited by the driven dipole and if the lengths and spacings are approximately correct, the beam will show good forward gain and small rear gain (or loss, preferably).

Working for maximum forward gain means a sharper beam pattern but an increase in the rear lobe, often a disadvantage in ıeception. Adding lots of directors increases the forward gain and beam pattern sharpness, but also narrows the antenna bandwidth. Sometimes, the bandwidth of long yagis is restricted to about 1 MHz of the 2m band before the gain and directivity turn from good to bad. This may be fine for long-distance work at one end of the 2m band but leaves much to be desired for coverage of the entire band and some of the MARS frequencies outside of this 4 MHz band.

The all-driven beam of three dipoles and a three-element parasitic yagi beam were built up and tuned to 432 MHz and tuned for minimum swr at this frequency. A General Radio wideband power oscillator was used to excite the antennas. The yagi had a bandwidth of 8 to 10 dB at the 3 dB points of gain and swr effects. The three driven elements had about twice the bandwidth before the gain went down and the swr went up badly. The forward gain was difficult to compare accurately but seemed to be about 6 dB with both antennas.

There were rear reflecting surfaces between one and two wavelengths in back of the test antenna position, so front-to-back measurements at this near-ground level were meaningless, and even the forward gain measurement was questionable. The main purpose was to compare swr over a wide band of frequencies with a slotted-line device in the same piece of coax that fed each antenna through baluns and tuning stubs at the antenna. No retuning was done after the original 432 MHz measurement; only the oscillator frequency was varied. These effects could be transferred to 2m by dividing the bandwidth figures by 3 without much error since the frequency is about one-third.

Swr measurements, using an ordinary swr meter, over the range of 143.5 to 148.2 MHz on the 12-element all-driven array showed it to be in the range of 1–1.2. This seemed to be very good to the old experimenter.

The polar diagram of the all-driven 12-element job of 6 over 6 elements also pleased me when compared to two 3-element yagis in broadside (also vertically polarized). The back lobe was small enough to make reception of weak signals possible in spite of bad power noises to the rear. The yagis were tuned for best forward gain and had a pretty bad back lobe as shown on the curve sheet. The rear lobe on the yagis was down about 10 dB from the front lobe. The driven array had 20 dB ratio. The fact of 3 dB more gain forward was due to stacking of 6 driven elements over the other 6, which should not affect the polar diagram pattern.

After a few months of on-the-air tests with three vertical beams at the same

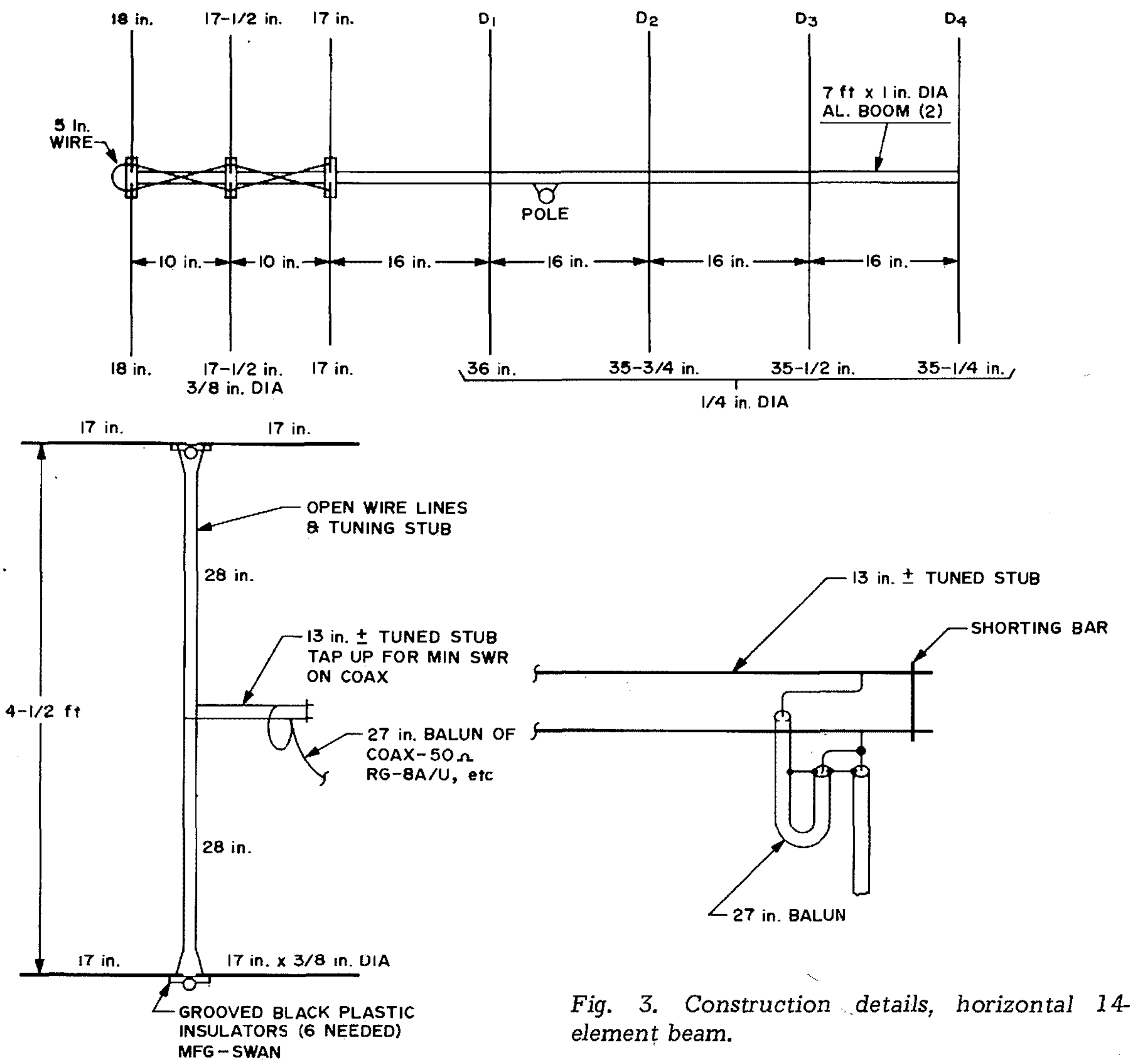


Fig. 3. Construction details, horizontal 14-element beam.

average height, the twin short yagi and the larger director beam (not shown) were pulled down and the all-driven 12-element vertical array boosted up as high as possible on its push-up mast for future use. The wide frontal lobe turned out to be a blessing since I could cover the whole San Francisco bay area with one beam bearing. The larger director beam had to be reset if the stations were more than 10 to 15 degrees apart in bearing, and its fairly large side and back lobes always picked up more noise when listening to weak signals.

The curves of driven-element antennas of Fig. 1 were interpolated from those of G. H. Brown (*IRE Proc., 1937*) for two elements for phasings of 60 to 180 degrees, and the curves of Chen T. Tai (Microwave Journal, 1964) for additional dipoles in driven arrays. If the interpretation of these curves is correct, two driven elements spaced $\lambda/8$ and phased at about 225 degrees would have a gain of 3 dB over a dipole and be nearly unidirectional. 180-degree phasing would provide nearly 4 dB gain but would be bidirectional, not a desirable characteristic for good front-to-back ratio.

A single reflector behind would add some forward gain and reduce the back lobe about 10 dB; however, a ratio of 20 dB was desired. An experimental model provided about 12 to 13 dB front-to-back ratio and a forward gain of about 5 dB.

Adding a third driven element gave better front-to-back results and is the form used in the beams shown in the photographs. Three driven elements phased about 225 degrees provided a little over 5 dB gain with at least 20 dB f/b ratio. The three elements gave a shade more than 2 dB improvement over two similar elements.

The dot-dash curve of Fig. 1 indicates that four driven elements would give about 1.5 dB more gain than three elements. An experimental antenna with five driven elements should have had 1 dB more gain, but as measured, did not prove much better than three elements. These experimental antennas require a lot of length and spacing variation to get best results.

The length of each driven dipole has to be shortened progressively from rear to front for best radiation pattern and gain characteristic. A short stub on the rear dipole and a tuning stub on the front element are needed to tune out some reactive components if coax or 300Ω twin-lead feeders are used. If several three-element beams are connected in phase, each one needs a short stub on the rear, four equal length lines at the front elements and a tuning stub and a balun for the whole array.

Half-wave spacing between three-element beams will add about 4 dB gain as checked by numerous measurements. Stacking six more driven elements below the top six elements will add 3 dB more gain, so if a good job of assembling and tuning is done, a 12-element beam will provide about 12 dB forward gain with exceptionally clean pattern as indicated on the polar diagram for a vertical array. (See Fig. 2.)

If directors are added to a driven array, the forward gain can be increased at the expense of a sharp frontal lobe, and two fairly large side lobes. Half-wave spacing betweeen beams can no longer be used since directors react badly with that spacing. Increasing the spacing increases the side lobes but finally up to 3 dB gain can be obtained with two beams as compared to one beam. No accurate gain measurements were made on the horizontal antenna, but some calculations indicated that its forward gain should be 1–2 dB more than the all-driven vertical array of fewer elements.

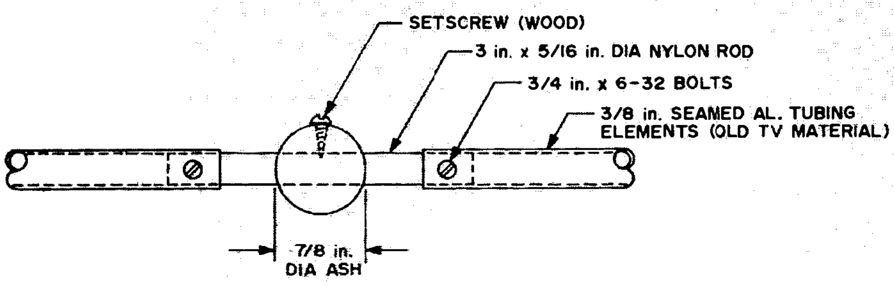
The horizontal beam insulators were of the type used in the very good Swan 2m beams (Fig.3). The 3/8 in. diameter aluminum tubing elements fit into grooves and are fastened in place with 6-32 machine screws. The insulators (six required) are grooved at right angles to the approximate 6 in. lengths, for 1 in. diameter booms each about 7 ft long in this array (two required). A small angle bracket about 2 ft long from the boom to the steel mast helps hold the booms parallel.

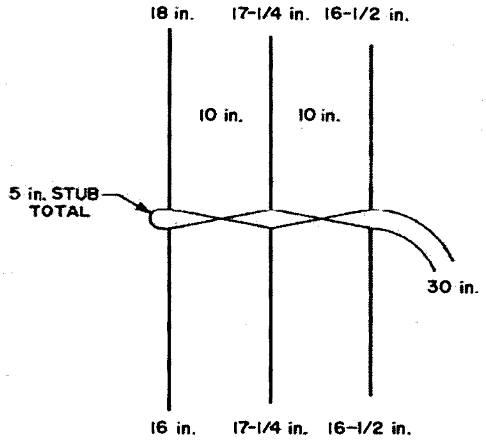
The usual TV ladder line is usable on moderate power at 2m but 13- or 12-gage bare wire is better. It can be melted into 5/16 or 3/8 in. diameter polyrod insulators cut into 1½ in. lengths. A 100W soldering iron (or better yet, a 200W size) will heat the wire enough to melt the polyrod around the wire when pressing firmly down on the wire at first over the polyrod then just to one side as the wire sinks into the insulator; 1 in. spacing is suitable for all phasing and tuning stubs. Insulator spacing of 10–12 in. is suitable for 14- or 12-gage wire lines.

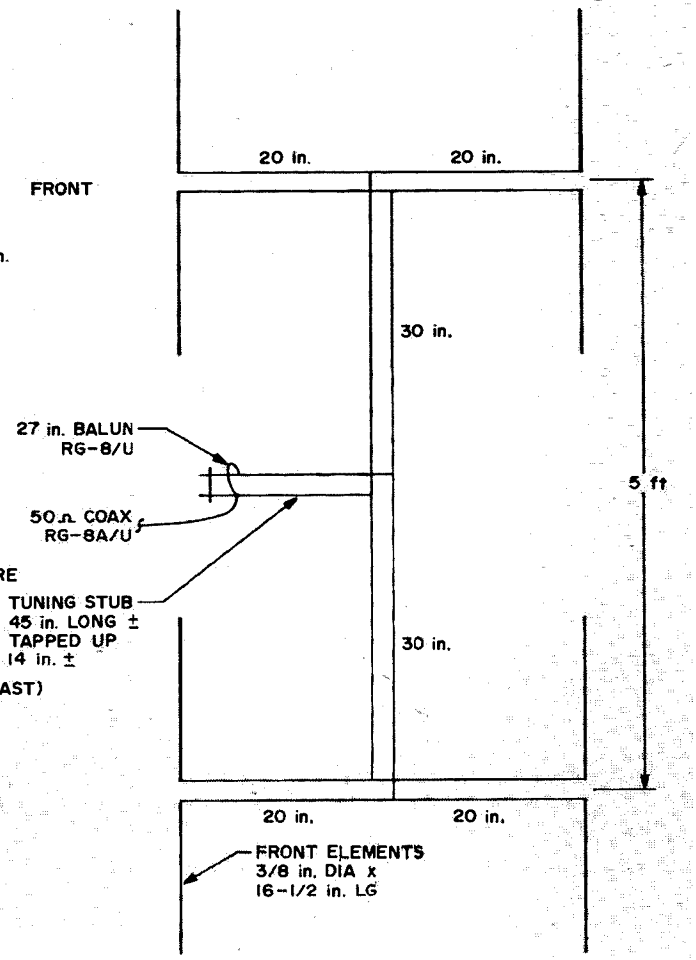
The all-driven array used 3 x 5/16 in. diameter nylon rod insulators since nylon is a very tough material and weathers better than fiber or Bakelite. There are other tough plastics which have better electrical characteristics than nylon, but rf losses at the center of dipoles is very low.

It will be noted that the driven element lengths taper towards the front (Fig. 4) and help take up some of the crossed phasing line reactance. The short rear stub of 5 or 6 in. of wire also helps in this respect.

The spacing of about 1/8 wavelength between driven elements would reduce the gain if the wires weren't crossed over between elements. Crossing these subtracts 180 degrees and the wire lengths of about λ/8 subtracts another 45γ degrees, giving about 225 degrees phasing between adjacent elements. This phasing gives about 2 dB more gain than 45-degree phasing for three driven elements. 135-degree phasing would give more gain but would be difficult physically because of trying to get 45+90 degrees instead of 180 and 45. Actually, the phasing is a little less than 225 degrees in these antennas since the driven elements are a little less than a half wavelength electrically. This gets the point of operation a little higher up on the middle curve of Fig. 1. At the point of maximum forward gain of about 160 de-







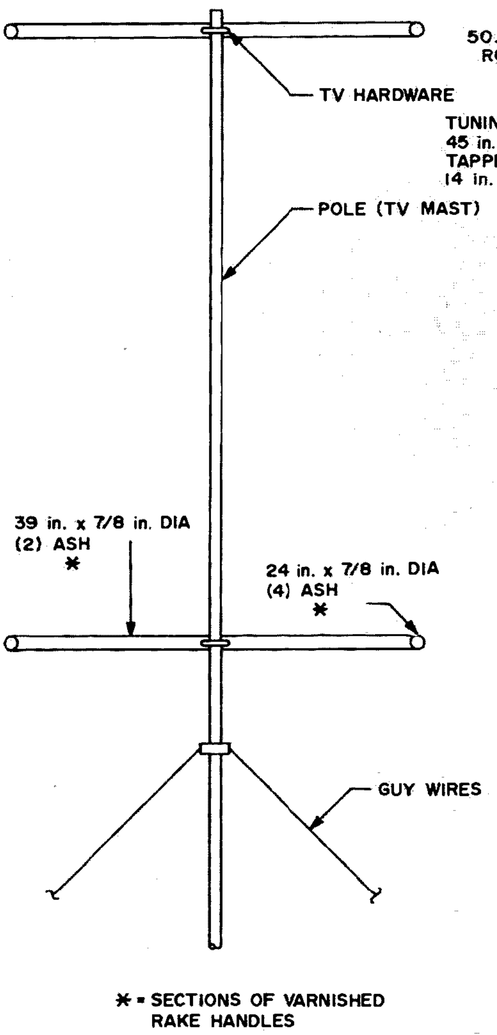


Fig. 4. Phasing, spacing, and other constructional details. Phasing lines, crossover leads, and tuning stubs are of 14-gage bare copper wire.

grees phasing, the front lobe becomes narrow and side and back lobes may be troublesome in the case of 2 or 4 units connected together in a larger beam.

The four-element curve of Fig. 1 was not obtainable in these experimental tests as the antenna tests always seemed to be nearly equivalent to the three-element curve.

...W6AJF■

3 SQUARES FOR TWO

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In answer to many requests from local VHF enthusiasts, I would like to share with you my successful experiences with a good 2 meter antenna which evolved from my need for a simple antenna that would add zest to my "Twoer" transceiver. Most VHF'ers use a yagi, skeleton slot, or multielement collinear. Some use a basic type omnidirectional antenna. All are good but have specific characteristics that offer many limitations (bandwidth, weight, expense, etc.). So if you want to be different and still enjoy a good signal without the worries of weight, expense, complicated fabrication, etc., you may want to do as I did – build a cubical quad.

The "cube" is ideal for the apartment dweller, being small and lightweight, excellent for Field Day and portable work, can be made to fold or come apart easily, and best of all, it's cheap. Mine has withstood winter weather and severe winds for nearly five years. However, one winter, due to extreme ice-loading and the weight of a rotor, the whole works toppled and crashed, bending the elements like confetti. No trouble, though. I merely straightened them as best I could and everything still works fine. So ruggedness may safely be listed as another of its attributes.

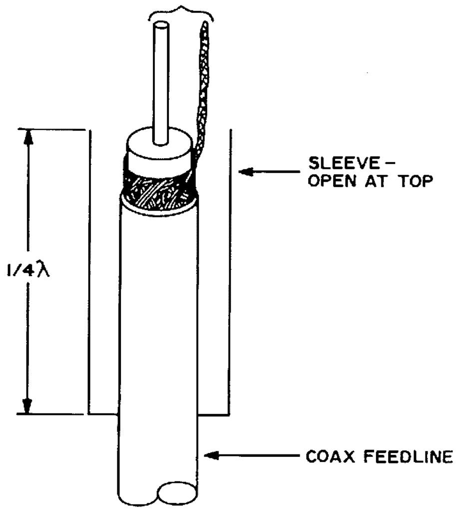
The construction is most simple and very inexpensive. All basic data was derived from the VHF Handbook. Much experimentation has gone into the "playing around" phase of it, but basically it is as it started out to be. Anything nearly resembling my prototype model should work well. (I say prototype as this was built in contemplation of building an advanced form of it later; but it worked so well I just kept on using it. This is a 3-element, but I would prefer and recommend 4 elements.

Naturally any suitable materials can be used for the boom and supports. I used a length of 1 x 1 in. wood, but broomhandles, dowels, etc., can be used. Spraying the finished framework with Krylon plastic spray or varnish is highly recommended: Last inspection showed the wood to be severely cracked all over and the boom warped even though it had been treated originally. Elements are made of aluminum clothesline wire, but copper wire may be preferred for ease of construction. The aluminum wire may be soldered only with a torch and aluminum solder, and it's tricky.

An easy method of closing the loops is by butt-joining the wire ends and crimping a short length of copper tubing (or aluminum) which has been slipped over the joint. The reflector and directors are closed loops whereas the driven element is open at the feed point by about 0.5 in. with the feed points mounted on an insulating block. Use anything plastic for the insulator. I found a piece of toy train track and this became my insulator.

The antenna is fed directly with 50Ω coax without the use of baluns. For a perfectly nonradiating line the coax should be fitted with a detuning sleeve, (see Fig. 2).

The elements are supported at the top and bottom center by either passing them through a hole near the ends of the vertical support pieces or by lashing them to the ends with wire, tape, staples or whatever is handy. Originally I stapled mine and when



COAXIAL BALUN
(DETUNING SLEEVE)

they got a little loose I criss-crossed electrical tape around the element and end of the support piece. It is truly haywire and sloppy, but it performs like a champ.

Design center frequency of my antenna is 145.26 MHz, but the builder can easily alter this by application of the antenna formula and charts given in the reference books. In theory the rule of thumb is to make the reflector 5% greater, and the director 5% smaller than the driven element length.

For experimenters wishing to calculate the exact lengths involved for a particular frequency the formula is:

El. length = 984/f (MHz)

For various element diameters a corrective factor (k) can be important as this will affect the bandwidth of the antenna. Following is a listing of some values of k for various element diameters for 144 MHz:

Element dia. (in.)	Value of k
1.0	0.960
7/8	0.961
3/4	0.963
5/8	0.964
1/2	0.966
3/8	0.967
1/4	0.969
1/8	0.972
3/32	0.973
1/16	0.975

An extremely thin antenna will operate properly only over a very narrow band of frequencies, while a thick antenna element will cover a proportionately wider band. Practical and desirable element diameters for 145 MHz antennas should be at least 1/8 in. or larger.

Here are the actual dimensions for my quad:

Boom	34 in.
Element supports	wood, 1x1;
Reflector	88½ in.
Driven element	81 in.
Director	76¾ in.
SPACING SPECIFICATIONS	
R to DE:	.12 wavelength
DE to D1:	.25 wavelength

Polarization is horizontal with a very wide beam pattern; the main lobe seems to be about 35 degrees, or just off the right front corner, with a null off the left front corner sighting the beamed direction.

For vertical polarization, just turn the whole works on its axis 90 degrees, so that the feed point is now on one of the sides. Feeding at the center of the vertical element will give vertical polarization, and at the center of the horizontal wire element will give horizontal polarization.

On-the-air tests have proved its value. Comparison tests were made using a 3-element commercial beam on the same mast with separate feedlines and a coax change-oever switch so that antennas could be switched readily and at any time during a QSO. The quad outperformed the beam in every respect in every QSO for a period of one week of testing. Most tests were performed with a Twoer and at heights not exceeding 30 ft. I do not know what the true gain of the quad is but it did boost the effective power and range of the Twoer by 7 over that of a "Big Wheel" omnidirectional antenna.

K8CFY■

References:
1. The ARRL Handbook
2. The Radio Amateurs VHF Manual
3. VHF Antenna Handbook by Jim Kyle K5JKX

"I CAN'T LEARN THE CODE!"

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There are some people who just cannot learn the code, and I guess I'm one of them. It's no use trying again, I'll only fail the exam. Sound familiar? If you really think like that, you are right – you will never learn it, even though you can.

For those who truly believe that they cannot learn the code, and who have actually tried, I would like to relate my personal experience in this endeavor.

Before I do, however, I would like to dispel some popular myths: You do not need to have any musical or other special talent to learn it. Anyone with reasonable intelligence can learn it.

There are three basic prerequisites to learning the code: an honest desire to do so (motivation), a belief that you can do it (confidence), and perseverance.

My code career began when I was about 10 or 11 years old. I became interested in amateur radio and began building crystal sets (ones with a cat's whisker) and other basic circuits. I also "learned the code" – that is, I remembered the complete alphabet and numerals. Why, I could even send the code with a "toy" code oscillator. The only trouble was that I couldn't copy it a bit when anyone else sent it at more than one word a minute. Later, when I became a boy scout, I thought it would be a cinch to get a "radio" merit badge. I didn't get it because I couldn't learn the code.

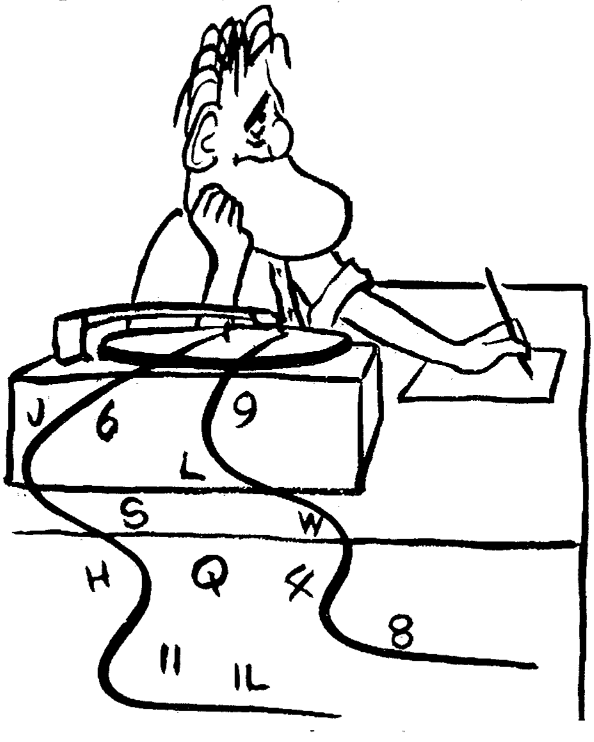
In high school, I joined a radio club that offered code lessons (1 hour a week). I thought "at last I'll get it." After one semester, I was advised by the instructor to give it up as I probably wouldn't make it and was holding up the rest of the group. Needless to say that by this time I was rather discouraged and believed that I would never be able to learn it.

Later when I entered the Air Corps my main desire was to become an aircraft radio operator. By that time I had progressed to building multistage receivers and test equipment, etc. I was given a chance to enter radio operators school. All I had to do was pass a simple test which consisted of signifying whether received signals were one, two, three, or four dots. The signal was sent and I was to indicate one, two, three, or four. I couldn't do it. No radio school for me! By then, I was really "brainwashed" and probably would have given up hope of ever becoming a ham. But, to my delight the Novice class was created with a 5 wpm code requirement. After several months of preparation, I somehow managed to pass and get a Novice

ticket. My first CW QSO ended in disaster. I called CQ and some other trusting Novice came back (I could recognize my call) but I never knew who he was because I couldn't even copy his call. Several more CQs furnished the same result. That was the end!

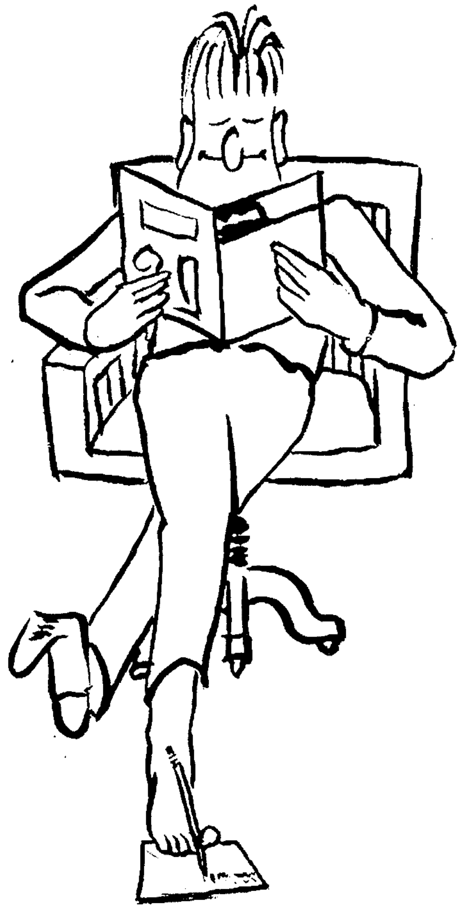
It would have remained the end except for the newly created Technician class. If you held a valid Novice ticket you only needed to take a General theory exam to qualify, which I did. At that time, 220 MHz and above were the only bands open to Techs. Later, when 6 meters was opened, I operated NBFM for 15 years or so. All this time I kept wishing I could get on 40 CW. By now I was 42 years old and thought "one more try!" I read all the articles on "how to learn the code," bought code records, etc., and once again set out for that elusive goal.

I set aside 15 or 20 minutes each evening and began. I soon realized that most code records were not what I needed as they progressed too fast. Next I began listening to the nightly W1AW code practice sessions. That is, when some "inconsiderate" wasn't giving them a bad time with QRM. That was the beginning. Two years later I managed to get up to the required 13 wpm and guess what? I passed



Most code records were just too fast for me.

the FCC exam on the first try! I now am active on 40 CW and have had many "successful" QSOs. I still listen to W1AW whenever I get a chance. I can now copy the 15 wpm text solid!



I still listen to W1AW once in a while and I copy it solid.

I wish to say that the W1AW code practice sessions were invaluable. I'm sure I could not have done it without their help. I am also certain, however, that if I had help from another person who was also learning the code I would have progressed faster. I also wish to say that there is one series of code records known as the "word method" which I recently obtained from the local library. I'm sure they would have helped if I could have gotten them sooner.

My experience in this matter has convinced me that anyone who wants to can learn the code provided he is willing to exert a little effort and is not easily discouraged. Many times during the last two years I almost gave up but I did notice some gradual improvement and stuck with it.

. . .WØFEV

COVERING ADDITIONAL FREQUENCIES WITH DIPOLES

Do you have a beam antenna and not know it?

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If your major antenna problems are deciding whether your new rotary beam will be a yagi or a quad, or a multibander or a singlebander, this article is not for you. We are aiming at two groups of amateurs. Those in one group consider themselves lucky to have any antenna at all. Any antenna they put up must be simple, inexpensive, easy to erect, and hopefully a good radiator on a number of bands. Those in the other group are enthusiastic participants in amateur radio's favorite outdoor sport – experimenting with antennas.

A ½λ dipole, center fed with low-impedance transmission line is simple, inexpensive, is easy to erect, and it is an efficient radiator. Unfortunately, it is usually considered to be a singleband antenna. Before proving that this belief is not necessarily true, let us see how it acquired that reputation.

First, at its resonant frequency, the center impedance of a ½λ dipole has a purely resistive value of approximately 70Ω and closely matches standard 50 and 72Ω transmission lines. But when a dipole is operated off its resonant frequency, its center impedance becomes complex and no longer matches low-impedance lines. At its second harmonic, for example, the center impedance increases to well over 1 kΩ and is obviously a very large mismatch to a low-impedance line – as trying to operate such a 3.5 MHz dipole on the 7 MHz band quickly proves.

At the third-harmonic frequency of the dipole – so the theory goes – the feedline again "looks into" the center of a ½λ dipole (that has a ½λ dipole connected to each end) and again sees a low-impedance resistive load. At progressively higher harmonic frequencies, the center impedance of the dipole swings between a very high value on even harmonics to a low value on odd harmonics.

These facts prompt many amateurs to attempt to use their 7 MHz, low-impedance, center-fed dipoles on the 21 MHz band as third-harmonic dipoles. The usual results are that it is impossible or difficult to load the transmitter properly on 21 MHz, and the measured swr on the transmission line is high. But all is not lost. Once we learn why these antennas apparently defy basic antenna theory, we can use the knowledge to persuade many other dipoles to work efficiently on two or more amateur bands.

The basic problem is that, although radio waves travel through space at the velocity of light – roughly 186,000 miles or 300,000,000 meters per second – their velocity of propagation slows down on a conductor. Consequently, a ½λ (the distance a radio wave travels in the period of a half cycle) is measurably shorter on a conductor than in space. Worse, the speed and shortening effect varies from conductor to conductor.

In an antenna, for example, the amount of shortening depends on the ratio of its length to its diameter, – and, especially, the capacitance between its end sections and surrounding space. As a conventional antenna has only two ends, no matter what its length, a short antenna (measured in fractions of a wavelength) is shortened a greater percentage than a longer one.

The standard formula for calculating antenna lengths compensates for this variable factor. The formula for the length in feet is:

$$L = \frac{(492)(n-0.05)}{f} \qquad (1)$$

where n equals the number of half-wavelengths in the antenna, and f is the frequency in megahertz.

When n = 1, (a ½λ dipole), the formula simplifies to:

$$L = \frac{468}{f} \qquad (2)$$

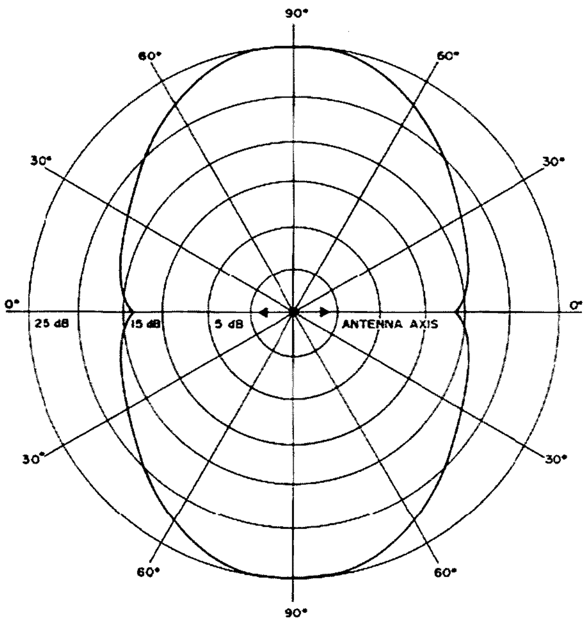

Fig. 1. ½λ antenna pattern

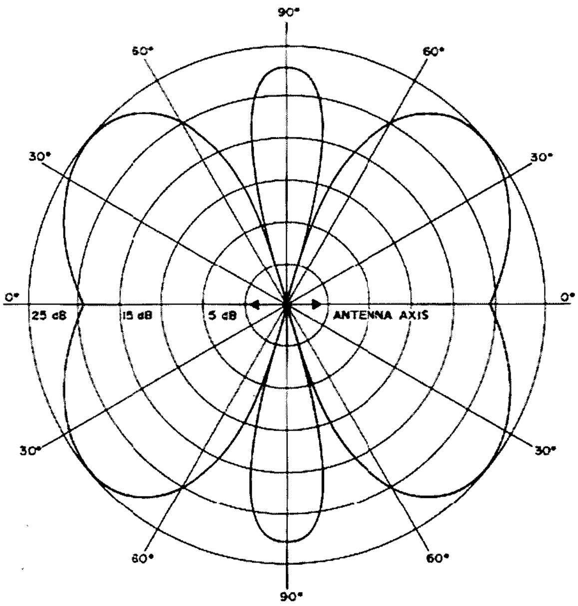

Fig. 2. 1½λ antenna radiation pattern

From either formula, the length of a ½λ antenna for 7.175 MHz (the center of the 7 MHz Novice band) is 65 ft, 2½ in. And Eq. 1 shows the length of a 1½λ antenna for 21.15 MHz in the 21 MHz Novice band to be 68 ft 7¼ in. Working the formulas backwards, the 7.175 MHz dipole has a third-harmonic resonant frequency of 22.25 MHz Conversely, the 21.15 MHz, 1½λ antenna resonates at 6.822 MHz as a ½λ antenna. Forwards or backwards, there is enough difference in the lengths of the antennas for an oversize yardstick.

These figures indicate why the average 7 MHz dipole does so poorly on the 21 MHz band. Being resonant far outside the high-frequency edge of the band is of minor importance as far as radiating efficiency is concerned. If we can get power into it, the antenna will radiate the power. Rather, the problem is that the off-resonant condition of the antenna produces such a high swr on the transmission line that the output circuits of most transmitters cannot compensate for the mismatch.

But if we increase the length of the antenna to make it resonant at the desired 21 MHz frequency, these problems disappear. In fact, the antenna should outperform a ½λ dipole for the same frequency, simply because a harmonically operated

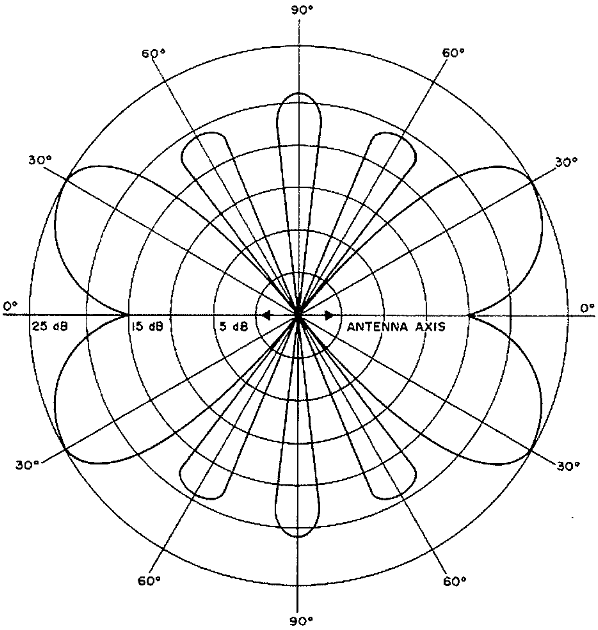

Fig. 3. 2½λ antenna radiation pattern

antenna exhibits gain in its favored directions over a ½λ dipole. While the gain of a ½λ antenna over a ½λ dipole is only 0.8 dB, it is enough to refute the belief of many amateurs that operating a low-frequency antenna on a higher-frequency band is an inefficient substitute for separate dipoles on each band.

At first glance, it may seem that increasing the antenna length for improved 21 MHz results is simply trading one set of problems for another. Certainly, the increased length resonates the antenna outside the low-frequency edge of the 7 MHz band. Fortunately, however, most transmitter output circuits have enough range on the 7 MHz band to compensate for the increased feedline swr at the operating frequency. And the mismatch is more acceptable on 7 MHz than on 21 MHz, because electrically a feedline of a given physical length is only a third as long is wavelengths on 7 MHz as it is on 21 MHz. Therefore, a particular value of swr increases the losses in the transmission line less on 7 MHz than on 21 MHz.

Moreover, if the antenna is an inverted V with the ends close enough to the ground to be reached without undue difficulty, its length can be adjusted for operation at the desired frequency on the 7 MHz band, and extensions approximately 20 in. long may be clipped to its ends for 21 MHz operation. The extensions may be allowed to drop vertically from the ends of the antenna.

Other antennas and other bands. Plugging the appropriate figures into the formulas will show that a ½λ dipole for 3.925 MHz (119 ft, 3 in.) will also resonate as a 3½λ dipole near 28.73 MHz. Other figures show that a 116-footer resonates near 4 MHz as a ½λ dipole and near 21 MHz as a 2½λ antenna. This pair of frequencies will not "turn on" many amateurs, but it might interest some MARS members. Also, if the ends of the antenna can be reached from the ground, butting it for 2½λ resonance in the 21 MHz band will permit clipping extensions to its ends for operation in the 3.5 and 28 MHz bands.

The possibilities: A Novice might cut his dipole for 2½λ resonance near 21.15 MHz and use 6½ ft extensions to reach 3.725 MHz. A General class phone operator, on the other hand, might select a length of 114 ft for 2½λ resonance near 21.36 MHz and 2½ ft extensions for operation in the 3.8 and 28 MHz bands. A third possibility is a 1½λ antenna for around 14.3 MHz (101 ft 6 in.). A couple of clip-on extensions at each end will permit operating on the 3.5, 21, and 28 MHz bands.

If you really want to think "big," a 3.7

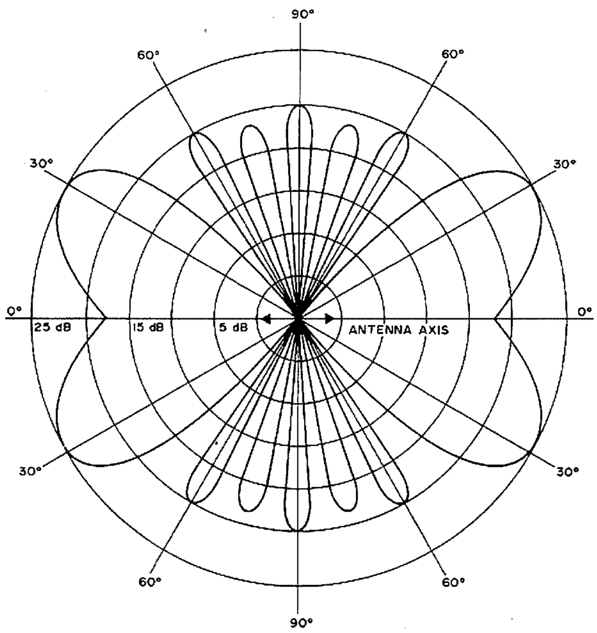

Fig. 4. 3½λ antenna radiation pattern

MHz Novice band antenna will resonate as an 18½λ antenna near 145 MHz. It will radiate its best signal on that frequency in lobes centered at approximately 18 degrees off the axis of the antenna. And it has a power gain approaching 10 dB over a ½λ dipole.

Figures 1 through 4 show the directional patterns of ½-, 1½, 2½, and 3½λ antennas. And Table I gives the gain in decibels and other information on selected antennas. As the diagrams indicate, the length of an antenna in half-wavelengths determines it number of lobes of radiation. One ½λ: one lobe; three ½λ: three lobes, etc.

A ½λ dipole's single lobe of radiation (per side) is at 90 degrees to the antenna axis, and its minimum signal is radiated off the ends of the antenna. Distance, frequency, and other factors determine the exact shape of the radiation pattern of any antenna. For a ½λ dipole, however, the difference between the points of maximum and minimum radiation averages a bit under 6 dB on the 3.5 MHz band and between 12 and 20 dB above 14 MHz.

In antennas longer than a ½λ, the major lobe of radiation in each quadrant of the antenna is the lobe that makes the smallest angle with the axis of the antenna, and the minor lobes fill in the other directions. Thus, the major lobes of a 1½λ antenna occur at 42 degrees off the ends, and its minor lobe is at 90 degrees. This lobe is only slightly weaker than the major lobes; therefore (except for the indicated sharp nulls), it has an almost omnidirectional radiation pattern. But as the antennas become longer, their major lobes stretch out and become narrower. Consequently, they become hot performers in the directions of their major lobes and fair performers off their minor lobes.

Feedline SWR. As shown in Table I, the radiation resistance of long-wire antennas increases from about 70Ω for a ½λ antenna to approximately 150Ω for a 6½λ antenna. (The 18½λ antenna mentioned above has an indicated radiation resistance of 165Ω.) Assuming a 75Ω transmission line, the line swr should not exceed 2:1 at antenna

Table I.

Performance Data for Various Dipole Lengths

Length λ	Gain dB	Radiation α, deg*	Radiation Resistance,* Ω
½	0	90	70
3/2	0.8	42 & 90	110
5/2	1.8	31	120
7/2	2.3	26	130
9/2	3.5	22	138
11/2	4.25	21	145
13/2	5	20	150

*With reference to axis of antenna

resonance for antennas up to 6½λ long. Under these conditions, a random-length transmission line could present either a resistive or a reactive load of up to 150Ω to the transmitter output circuit.

Not all transmitter output circuits can successfully handle complex impedances over 100Ω. But, by making the line length an odd number of electrical quarter-waves at the highest frequency – where the antenna impedance is highest – the transformer action of the transmission line will transpose the high impedance to a low impedance at the transmitter.

Use the formula

$$L = \frac{246\nu}{f} \qquad (3)$$

to determine the physical length of an electrical ¼λ of transmission line. The velocity factor (ν) is 0.66 for conventional "RG" coaxial cable, 0.80 for polyfoam, and 0.71 for kilowatt 75Ω twinlead (*Amphenol* 214-023 or *Belden* 8210). Assuming RG-11/U cable and a frequency of 21.3 MHz, the lnegth is 7 1/3 ft.

Now estimate the length of transmission line required to reach from the antenna to the transmitter. Divide this length by the length calculated above. Choose the nearest odd whole number equal to or greater than the result of the division. For example, if the distance from the antenna to the transmitter is 50 ft, an actual feedline length of 51 1/3 ft (seven electrical quarter-waves).

Who said a ½λ dipole fed with low-impedance cable is a singleband antenna?

W9EGQ■

WEATHER BALLOON VERTICALS

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With a CW DX contest coming up, I wanted to have a really effective antenna system for 80 and 40 meters. As my backyard is not very large, it was obvious that a vertical antenna of some type was needed. I was reading through back issues of 73 and other magazines getting ideas on antenna designs, when I found an interesting article on theoretical performance of 5/8 wavelength verticals, which supposedly would give maximum lowest-angle radiation on the first major lobe of radiation.

This was just what I needed. The article went on to state that if the antenna wavelength was increased any further than 5/8 wavelength, the major radiation lobe would begin to decrease in strength, although it would give a still lower radiation angle. I decided to shoot for the 5/8 wavelength goal, as this would give approximately 14-degree vertical radiation, very useful for DX.

I purchased an 8 ft diameter weather balloon from Edmund Scientific Co., 150 Edscorp Building, Barrington NJ 08007, for $2 postpaid. It's made of Neoprene and holds helium very well.

I bought a small cannister of helium. Don't forget to obtain a suitable fitting for the nozzle opening. The welder threw in a fitting with my helium, provided that I return it with the empty cannister.

My neighbor, WB4NFX, opened the cannister valve with a wrench while I held the balloon tight around the fitting. We filled it slowly, making sure no gas was escaping. At 3½ ft diameter, the cannister was empty, but the balloon was floating! We tied the balloon neck with heavy string in two places, as shown in Fig. 1. Watch your ceiling! Mine is made of a rough-finish plaster with sharp projections protruding perilously. No accidents here, though.

I measured 162 ft of wire. I tied one end to the balloon, the other to an insulator anchored to a 5 lb brick. The antenna wire was fed to the center conductor of RG–58/U coax, the coax shield

Balloon dia, ft.	Gas vol, cu. ft.	Lift power, lb (with He at 32° F)	Lift power, lb (with He at 70° F)
2	4	1/4	1/4
3	14	1	3/4
4	33	2	2
5	65	4	4
6	113	7	7
7	180	12	11
8	268	18	17
9	381	26	24
10	523	36	33
11	696	48	44
12	904	62	58
13	1150	79	73
14	1436	99	92
15	1767	122	113
16	2144	148	137

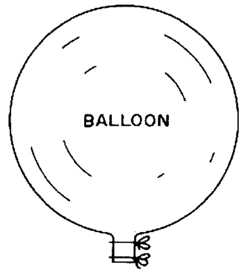

Fig. 1. Balloon lift and helium fill requirements. Note string is tied twice on balloon neck.

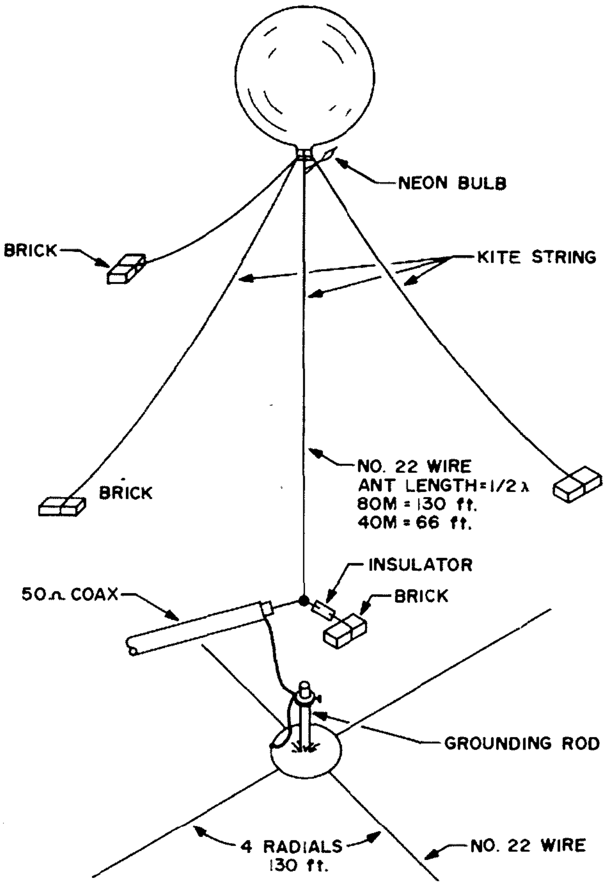

Fig. 2. Kite-string "guys" will hold balloon well even in wind. Be sure to ground the coax lead to an earthrod.

connected to a rod driven into the ground beside the brick, four 130 ft radials were connected to the ground rod and left lying on the ground, each radial 90 degrees apart. (See Fig. 2.)

With this 5/8 wavelength vertical, a matching network is necessary, so I jury-rigged a tuner with some B & W coilstock and a transmitting-type variable capacitor. Tapping off turns on the coilstock with alligator clips, we obtained our lowest swr, which was about 4:1! Band: 80m.

We had a QSO on CW with W6EAC in San Mateo, who gave us an RST of 559! It was obvious that the Apache's 180W just wasn't doing its thing for us.

Recalling in some gray matter that a half-wave vertical offers a better match to 50Ω coax, I hurriedly ran out into the backyard with a tape measure and cut off 32 ft of the wire. Don't forget to hold the balloon! Back in the shack, we removed the tuner and connected the coax directly to the transmitter's SO-239 connector. We tuned up and called W6EAC again on 80m. RST was 589 and peaking 599 through the QSB!

At the end of our QSO, the plate current went wild. Running out back again (I was huffing and puffing by this time), I was amazed to see that the balloon was at 2000 ft and still rising, trailing 100 ft of wire!

I made the mistake of using 30-gage wire, and the rf burned the wire in two!

Another balloon and another cannister of helium later, we prepared a second antenna. Again, WB4NFX opened the cannister as I held the balloon tight against the fitting. Using 22-gage wire this time, *and a* ball of kite string as a safety measure, the balloon went up without a hitch. An NE-2 neon bulb was attached to the wire just under the balloon and would tell me if the wire burnt up again. 130 ft of wire was used, which is a half-wavelength on 80m.

The same antenna was used on 40m, also with good results. However, bear in mind that 130 ft of wire is one wavelength on 40m, and the major lobe of radiation has decreased in power – 66 ft of wire would have given better results on 40.

The helium balloon will remain aloft for 2–3 days. Three kite-string "guy wires" would hold such a balloon in a fixed position in wind. Most ham "contests" last only 48 hours, so the balloons should be filled just before the start of an event.

In the VP7AS pileup on 40m, I only had to wait once before he answered my call. In previous pileups, I've waited a BUNCH! When I reduced power from 180W to 35W, my RST changed from 589 to 579.

All QSOs were made with 180W input. I've often wondered what a kW would do to signal reports.

The following chart will give you an idea of the helium required, balloon diameters, and lifting characteristics.

K4EPI will use balloon verticals in future contests. These will be mainly on 80 and 40m. A half-wave balloon vertical on 160m has not been tried, but should perform better than a dipole. Perhaps this is all W1BB needs to get that 100th country on 160!

...K4EPI■

Squelch addition for the pocket pager

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The Motorola VHF pocket pager is a completely self-contained FM receiver operating in the 136–174 MHz band. If it were not for the fact that it had to be keyed by a tone to denote the presence of a carrier or that it had to have its push-to-listen button constantly depressed in order to hear anything, it would make an ideal monitor receiver adaptable to amateur use on 2 meters, or for eavesdropping on the 150 MHz public service band. The main objective of this article is to remove the tone circuitry and to replace it with a squelch that can be triggered with the presence of an rf signal tuned to the frequency of the pager.

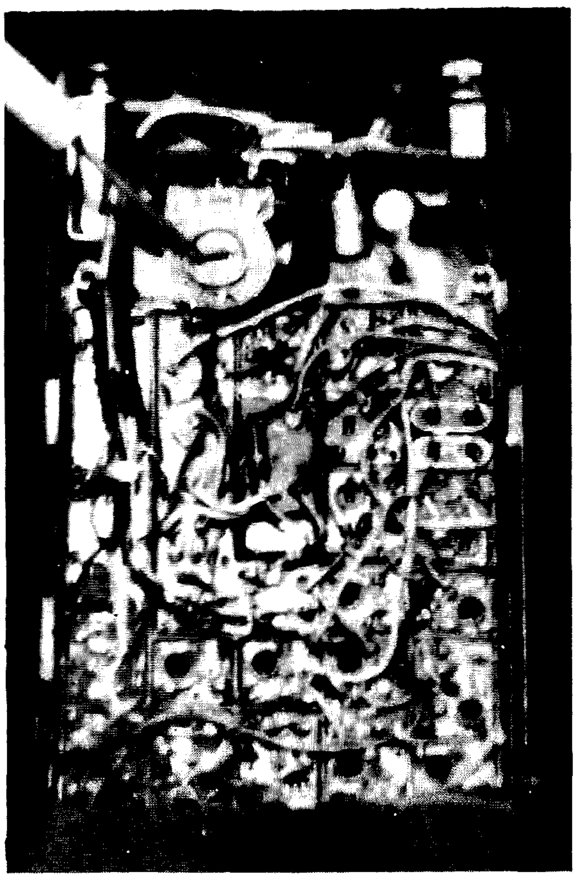

Photo showing location of squelch control inside of pager housing.

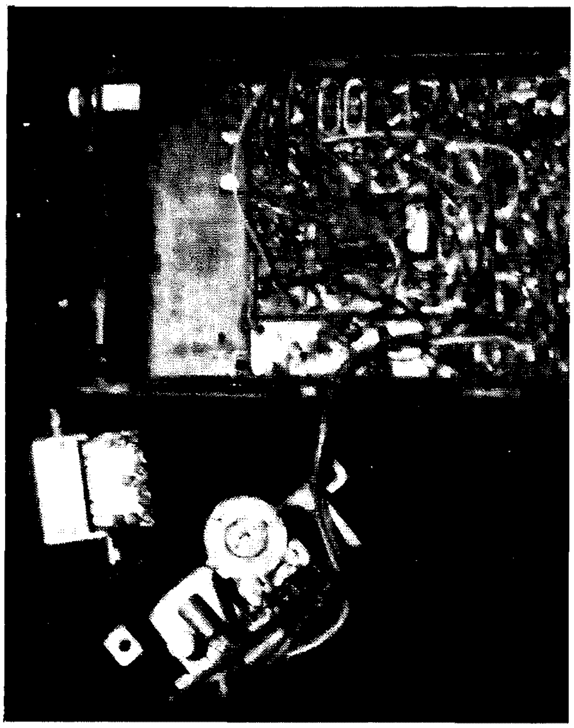

Photo showing squelch board and push-to-listen switch removed from pager.

It is not too difficult to remove the tone circuitry and to enable the receiver to work all the time; but the noise present when a carrier is absent may prove to be very annoying. By adding a squelch to the pocket pager, the receiver will remain silent until there is an rf carrier present to trigger it on.

Before proceeding to modify the pocket pager, the operation of a noise squelch should be discussed. First of all, the squelch circuit I have used has three basic stages: filter network, two-stage amplifier, and a switching transistor.

With no rf carrier present, the rushing sound coming from an unsquelched receiver is known as air noise. What is

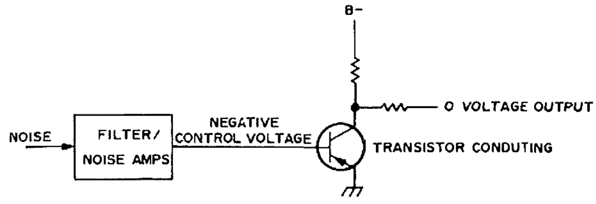

Fig. 1. Squelch operation without carrier.

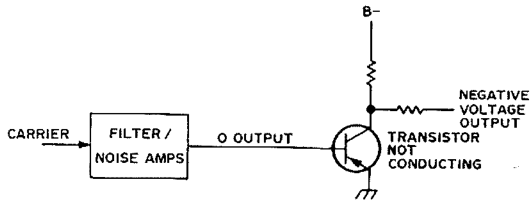

Fig. 2. Squelch operation with carrier.

accomplished is that the noise is filtered, amplified to a usable level, and used to control the squelch switching transistor. (See Fig. 1.)

With no signal present, all the pager will receive is noise. This noise is picked up by

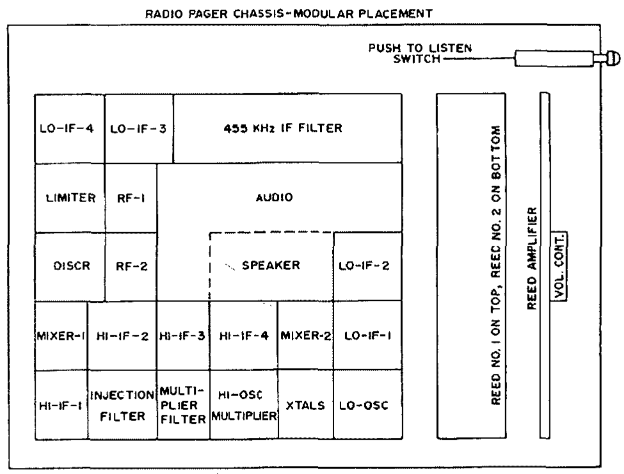

Fig. 3. Layout diagram showing location of pager components and stages.

the filter and coupled to the noise amplifiers. After amplification, the noise is a negative-going signal. This negative signal is then applied to the base of a switching

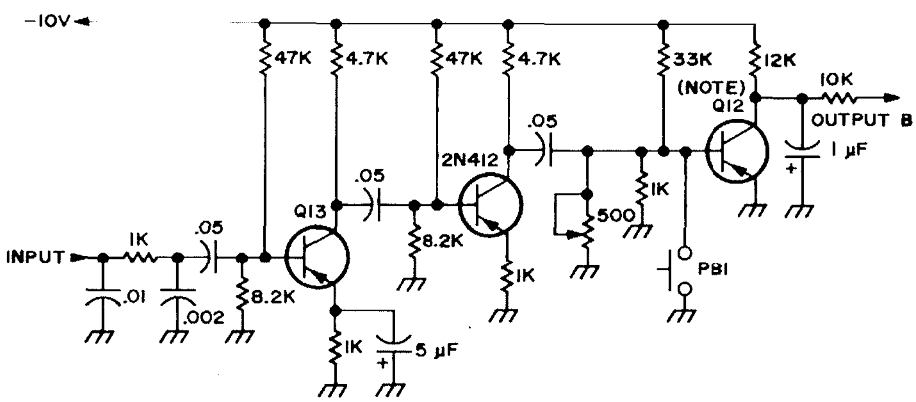

Fig. 4. Schematic diagram of noise-actuated squelch unit.

transistor which will place the transistor into a state of conduction.

In the presence of an rf signal such as is represented in Fig. 2, there is no output from the noise amplifiers. This zero potential when applied to the base of the switching transistor will do nothing, and the transistor will cease to conduct.

The first stages of modification will concentrate in the removal of the tone and push-to-listen circuitry from the reed amplifier board. By following the instructions step by step, no difficulties should be encountered and a very neat modification should be the result, leaving plenty of room in the crowded chassis to incorporate a squelch. Before proceeding in the removal of the tone circuitry, I might point out that only certain parts are going to be removed; so don't get carried away removing all the components. Refer to Fig. 3 during the removal of the circuitry.

Steps required for removal of tone and push-to-listen circuitry.

1. Remove reed amplifier board, reed 1, and reed 2 from unit, leaving wires intact.
2. Disconnect wires on four solder lugs of reed 1, reed 2; set reed relays aside.
3. Remove orange and green wires interconnecting reed 1 to reed 2 and set aside.
5. Remove metal mounting bracket on reed amplifier board and temporarily set aside.
6. Unsolder the orange, yellow, and brown wires from reed amplifier board that previously went to reed relay and set aside.
7. Remove tape and cable restraints from push-to-listen switch.
8. Unsolder red and brown wires from push-to-listen switch.
9. Cut brown wire that previously went to push-to-listen switch about 1½ in. away from its soldered connection on the audio board.
10. Unsolder red wire going to the audio board previously connected to the push-to-listen switch.
11. Solder loose end of 1½ in. brown wire of step 9 to terminal on audio board where red wire was just unsoldered in step 10.
12. Unsolder gray wire from push-to-listen switch and cut 1 in. from terminal on audio board.
13. Remove the white wire with brown tracer, the white wire with green tracer, the white wire with red tracer, the white wire with blue tracer, and the yellow, blue and white wires from the push-to-listen switch.
14. Unsolder white wire with brown tracer from terminal on audio board, set aside, and solder the 1 in. gray wire in step 12 to that terminal.
15. Unsolder other end of white wire with green tracer of step 13 from terminal on audio board and set aside.
16. Remove knob from volume control.
17. Take 5½ in. piece of yellow wire previously used with reed relay. Remove yellow wire from terminal on audio board that previously went to push-to-listen switch and solder 5½ in. yellow wire in its place.
18. Unsolder blue wire going to volume control on reed amplifier board and set aside.
19. Solder other end of 5½ in. yellow wire used in step 17 to terminal where blue wire in step 18 had previously been soldered.
20. Cut wire with blue tracer ½ in. from terminal on audio board.
21. Cut white wire with red tracer ¾ in. from terminal on audio board.
22. Unsolder white wire that previously went to the push-to-listen switch from speaker terminal board.
23. Solder ½ in. white wire with blue tracer and ¾ in. white wire in step 22 was previously connected.

At this point, the VHF pocket pager is operative and any carrier tuned to the frequency of the pager will be heard without the need of a tone signal or of having to depress the push-to-listen button.

With the reed relays and some of its associated wiring removed, there is sufficient room to construct the squelch (Fig. 4). The complete squelch, including the potentiometer, is constructed on the reed amplifier board. Figures 5 and 6 show a phantom view of the reed amplifier board and parts placement before and after modification.

Steps required for addition of noise operated squelch.

1. Remove R47 (100) and replace with a 1 kΩ resistor and a 5 μF capacitor.
2. Remove R44 (10K) and RT1 (10 kΩ) and replace with an 8.2 kΩ resistor.
3. Remove C49 2 μF electrolytic.
4. Parallel R42 (1 kΩ) with the 500Ω potentiometer.
5. Remove R43 (4.7 kΩ.
6. Disconnect the base and the emitter of transistor Q12. Connect the base where the emitter was previously located and connect the emitter to ground.
7. Remove CR6.
8. Remove CR8 and replace with .002 μF capacitor.
9. Remove R64 (15 kΩ).
10. Remove R63 (220 kΩ) and replace with an 8.2 kΩ resistor.
11. Remove C53 (1 μF) and replace with a 1 kΩ resistor.
12. Remove C51 (1 μF) and C52 (1 μF).
13. Place .01 capacitor between emitter of 011 and ground.
14. Place 1 kΩ resistor between emitter of Q11 and junction of C71 (.05) and C3 (.002).
15. Remove R46 (82 kΩ).
16. Remove CR5 and replace with a 4.7 kΩ resistor.
17. Remove R48 (1 kΩ).
18. Place 2 wires (5 in. long) to two normally open contacts of the push-to-listen switch. Connect one of those wires to ground and connect the other wire to the base of Q12.
19. Insert C6 (1 μF) from collector of Q12 to ground. Connect positive end to ground.

20. Remove C72 (2 μF), R67 (27 kΩ), and R68 (22 kΩ) from the audio board.
21. Insert a 4½ in. piece of wire between point B on the reed amplifier board and point A on the audio board. (See Fig. 6).
22. The following parts and jumper wire should now be inserted as per Fig. 6.

Q20-2N412	R6-47 kΩ	R10-10 kΩ
C1-.01	R8-33 kΩ	R11-4.7 kΩ
C5-.05	R9-12 k	R14-47 kΩ

On completion of all these steps, the unit is ready to be put back together. After the push-to-listen button and the reed amplifier board are reinserted, the squelch

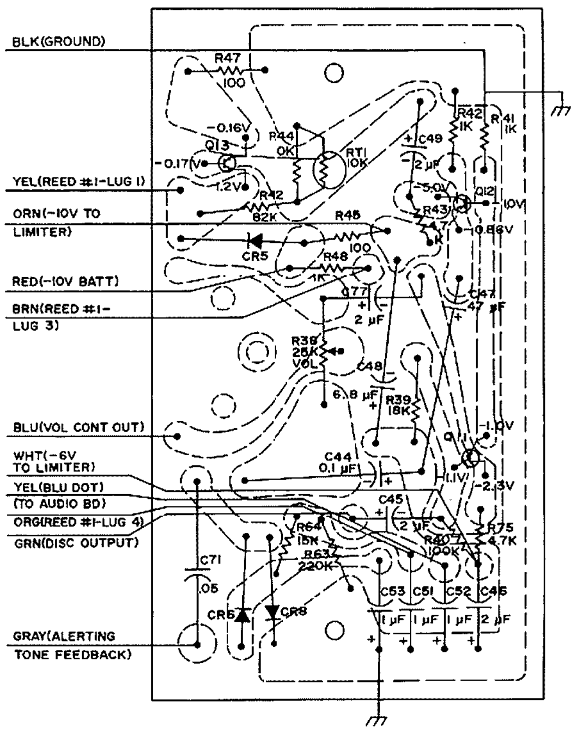

Fig. 5. Phantom view of copper side of reed amplifier board showing parts location before modification.

control can be set to eliminate any noise present in the absence of a carrier. The push-to-listen button is now a squelch-defeat button. At this point, the back can be secured and the squelch modification for the pocket pager is completed.

Here is some crystal correlation data used for changing the frequency of the pager. The recommended alignment tool for adjusting the transformers is either the Motorola type NLN6127A/NK111 or the more readily available GC9440. The crystal closest to the reed amplifier board is the intermediate frequency crystal Y2.

If the intermediate crystal Y2 is 11.545 MHz, the i-f is 12 MHz, and the high oscillator crystal calls for a Motorola type YM-29.

If the intermediate crystal Y2 is 11.245 or 12.155 MHz, then the i-f (f_i) is 11.7 MHz and the high oscillator crystal should be a Motorola type YM-35. The formula used for determining the frequency of the high oscillator crystal Y1 is as follows:

$$f_{Y1} = \frac{f_o - f_i}{3}$$

Where: f_{Y1} = Crystal Frequency
f_o = Frequency of operation
f_i = Intermediate frequency

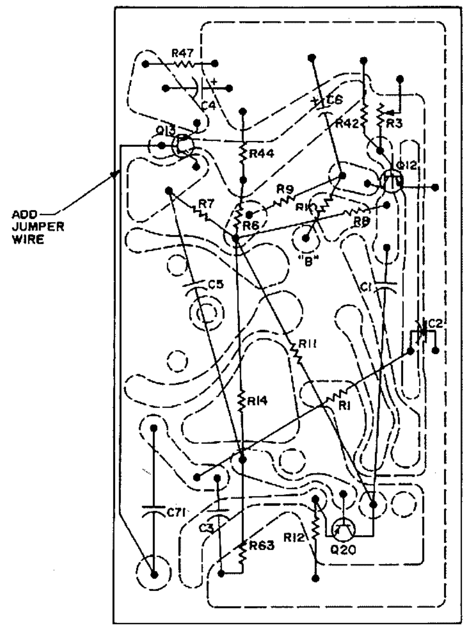

Fig. 6. Phantom view of copper side of reed amplifier board showing location of squelch after modification.

This pager (Newsome Electronics, $34.95), when properly adjusted, should operate superior to any other type of VHF pocket receiver available at this price. In strong reception areas the built-in antenna of the pager should be adequately sufficient. To increase reception, simply plug an 18 in. whip into the antenna jack. Whether the Motorola pocket pager is used for listening on the 2 meter ham band or for eavesdropping on the public service band, it ought to be good for many hours of enjoyment. . . .WA8PIA■

The 2N412/HEP 3 ($1.25) is available from Circuit Specialists Co., Box 3047, Scottsdale AZ 85257. Please include 25¢ for shipping.

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VFOing the Twoer

Many of us 2 meter QRP diehards are using the Heathkit Twoer, a little 5W transceiver. Aside from 100 kHz receiver selectivity, we also wish for vfo control. Thank your local apostle, here's how.

Step 1: Get a vfo. This isn't too hard; the Knight V-107 vfo is perfect. Its output is about 15V, just fine for the Twoer. Build a separate power source supplying all the voltages that it needs.

I'm using the Heath HG-10B vfo. A few modifications are necessary. In the Twoer, add a .001 μF 1 kV capacitor from pin 8 of V5A to ground, and change R2 from 22 kΩ to about 18 kΩ. Now the tube is an amplifier for the vfo instead of an oscillator. The vfo input goes directly into the pin 7 side of the crystal socket.

In the HG-10B, connect a shorting wire across the 10 kΩ, 10W resistor, and change the OB2 to an OA2 or OD3A. Build a separate power supply, with a filtered 175V dc, at about 30 mA, 6.3V ac or dc at 1A, and -70V bias, as shown in Fig. 1. The bias is connected via the green wire of the HG-10B. On terminal strip A, disconnect the green wire from terminal two and solder it onto terminal three. Remove the jumper on the key jack, between terminals two and three.

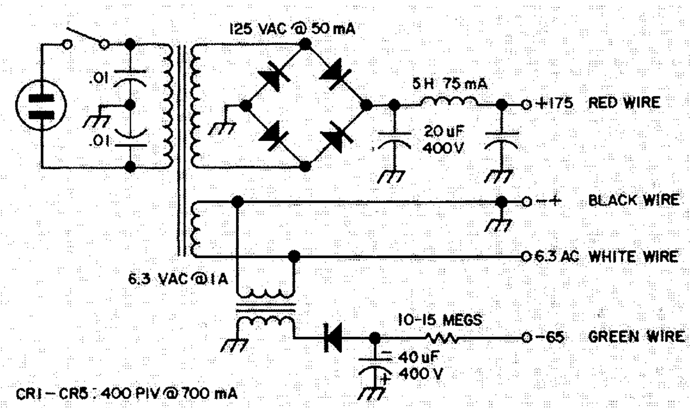

Fig. 1. Schematic

The second wish is to increase the selectivity of the Twoer. Simply change R10 to anywhere between 20 and 30 MΩ. (It's the one mounted on that big coil in the center.) This will change the calibration but not the sensitivity of the receiver.

My thanks to W. J. Remer K8GND, of the Heathkit technical staff, for his help in the modification of my Twoer.

. . .WA3HWI■

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Transmitter Tuning of Mobile Antennas

A method is presented for utilizing the high Q loading inductor of a low frequency mobile whip as part of the transmitter output circuit to permit wideband operation of a short mobile antenna. The simple modifications necessary to typical transmitter output circuits are illustrated by several circuit diagrams.

The usual approach to low-frequency mobile antenna construction is illustrated in Fig. 1A. A short whip antenna is used which is either base or center loaded so that the antenna has an effective electrical length of ¼λ and can be directly connected to a non-resonant coaxial transmission line. In order to reduce ohmic losses in the loading inductor, its "Q" is made as high as possible. The high "Q" results in greater radiation efficiency due to the reduced I^2R loss but it also results in a very restricted bandwidth for the antenna – 10 to 20 kHz being typical for many 80 meter mobile whips. Whenever one wishes to change the transmitter frequency to any great degree, it is necessary to readjust either the loading inductor on the antenna or the length of the whip antenna itself.

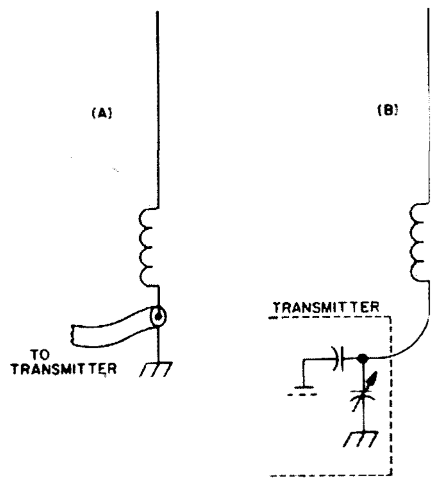


Fig. 1. Usual base or center loaded whip antenna which utilizes a non-resonant transmission line (A). Concept of using the high Q loading coil directly as part of the transmitter tank circuit.

It should be recognized that even with high-Q loading inductors, the radiation efficiency of an 8 ft whip on a low-frequency band is a matter of a few percent. No manner of loading inductor is going to make an 8 ft whip radiate like a 60 ft whip unless the losses in the loading inductor can be reduced to zero, a condition only possible if the *resistance* of the loading inductor can be reduced to *absolute* zero. The restricted bandwidth of low-frequency whip antennas is due to the fact that it is desired to have them self-resonant and operate into a non-resonant transmission line. This concept has no real basis as far as improving the radiation efficiency of an antenna in a low-frequency mobile installation and simply imposes a severe bandwidth restriction upon the operation of the mobile installation.

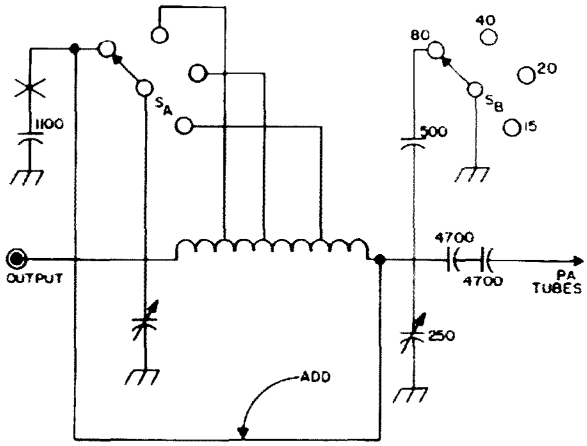


Fig. 2. Simple tank circuit switching connections changes necessary to bypass pi-network coil on 80 meters only. Circuit shown is for SB-34 but typical of a wide variety of transceivers.

Non-Resonant Loaded Whips

If one considers the loading inductor used either at the base or center of a whip as necessary to increase the effective electrical length of the antenna to the point where the antenna system can resonate at a given frequency, there is no theoretical reason why this resonant circuit cannot simultaneously act as both the resonant output circuit for a transmitter and as the radiating medium or antenna for the transmitter. This concept is illustrated in **Fig. 1B**. The line section between the whip and transmitter also becomes part of the radiating antenna.

This idea is not really new and, indeed, in basic concept goes back to the earliest days of radio. Some readers will immediately relive some of the nightmares of harmonic radiation and interference that were present using AM transmitters with class C output stages when they look at **Fig. 1B**. However, several factors have changed which make the scheme much more practical now, mainly the use of linear output stages and the high Q of most loading inductors. The scheme is certainly not recommended for fixed station usage in a location where TVI is a problem already, since the output is not filtered and harmonic reduction is mainly a function of that provided by the single tuned circuit which is involved. However, for mobile use, the scheme does have particular appeal; although the possibility ignored. Mobile operation is often conducted remote from housing areas and the approximate 30 – 40 dB second harmonic attenuation provided by most good loading coils tuned as shown suffices with low power transmitters to avoid any interference problem. This is especially true for mobile operation on 80 meters.

Practical Considerations

When the scheme of **Fig. 1B** is used, only the variable capacitor in the transmitter need be adjusted for wide frequency excursions once the loading inductor and capacitor values have been balanced to provide proper transmitter loading. This adjustment is described in more detail later, but in most cases, the adjustment range required is within the existing range of the component values of the variable plate tuning capacitor within the transmitter and of the whip loading inductor. No component modifications need be made in most cases.

One area that does require some minor modification, however, is the line between the whip antenna base and the transmitter. Since the line becomes part of the antenna circuit, it will radiate and, also, it will carry the greatest portion of the antenna current. The radiation that takes place from this line where it runs in the automobile is, of course, shielded by the automobile body and lost. However, as was mentioned before, the radiation efficiency of a loaded

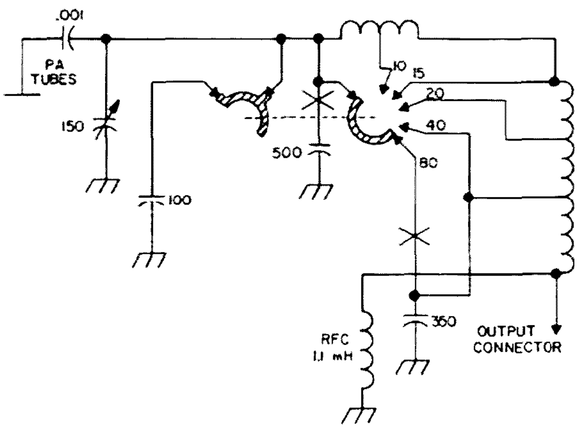


Fig. 3. Pi-network circuits employing continuous shorting type switches may be slightly more difficult to modify. The output circuit of the Heath HA-14 linear is shown. Although the switching arrangement shown may appear correct, it actually has several faults. See Fig. 4.

low-frequency whip is only several percent anyway and the additional radiation lost is not significant in most practical situations. It certainly is a small price to pay for the ability to tune a mobile rig freely across major portions of a band. Nonetheless, the line should be kept as short as possible.

Because of the heavy current that flows in the line, it should be made from heavy wire—and not just the inner conductor of a small coaxial cable. Heavy battery cable of the type with a thick covering, in order to provide the necessary voltage insulation, or the inner conductor and dielectric of a really heavy coaxial cable (shield removed) such as RG 14/U or a larger cable should be used.

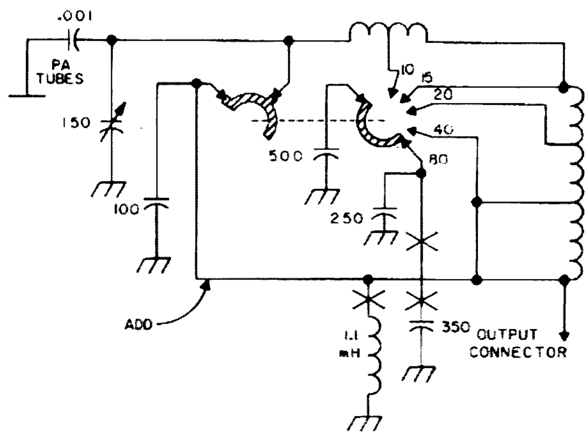


Fig. 4. Although an extra component must be used, this modification to the HA-14 output circuit provides a far better switching arrangement than that shown in Fig. 3.

Output Circuit Modifications

If a multiband transceiver is used for mobile operation, it may be found advantageous to use the method described for mobile antenna coupling on 80 meters, or both 80 and 40 meters, and a conventional loaded mobile antenna feed by a coaxial transmission line on the higher frequency bands. This situation occurs since the radiating portion of the feedline which is enclosed within the automobile increases in terms of wavelength with higher frequency and the losses encountered with the antenna coupling method of Fig. 1B exceed those of the method illustrated in Fig. 1A.

Therefore, it is very handy to provide some modification to the output circuit of a transceiver or transmitter such that it can be used with the antenna coupling arrangement of Fig. 1B on one or two low-frequency bands and with a conventional, unmodified coupling scheme on the higher frequency bands. Figs. 2–4 show details of various modification methods to typical pi-network output circuits. The only other switching involved is then that concerning the transmission line which can be done manually or with relays.

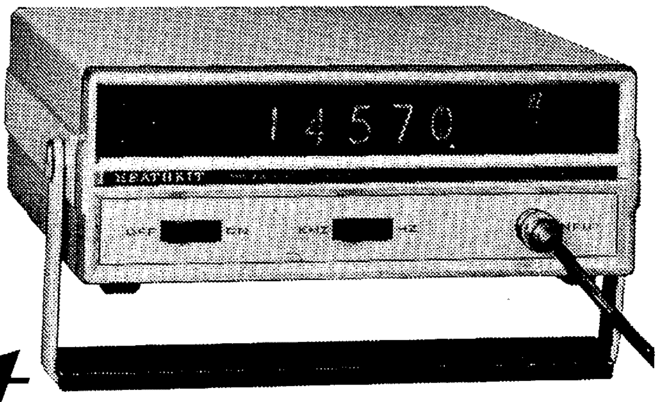
Adjustment

Initial adjustment should be done at a low power level by reducing the drive to the output stage of a transceiver. The output loading capacitor (which is in parallel with the plate tuning capacitor once the transceiver is modified) is initially set at minimum although it can be used later if more capacitance is required. The drive is increased and the transceiver checked for the usual meter indications of resonance and proper loading. If resonance is indicated but the loading is not correct, one can try increasing the value of the plate tuning capacitor by changing its setting and reducing the value of the antenna loading inductor (or vice versa) until adequate loading is achieved.

One must use a wavemeter or some other device to check the radiated frequency since it is possible to have the system falsely tuned in some cases. When the system is tuned correctly, one should also be responsible enough to check the harmonic radiation and interference levels as compared to the usual setup. Although with the use of linear amplifiers, etc., the harmonic level should be well below any illegal level, it certainly would be completely irresponsible to operate without being certain of this. A check with a receiver tuned to the various harmonic frequencies will quickly indicate if the harmonics are at least 30–40 dB down from the fundamental frequency.

. . . W2EEY

I built a counter



Kendall Sessions III

My neighbors say I have a "way" with electrical things. They always bring me their TV sets whenever a tube goes bad or a fuse blows or a wire breaks. And when I fix the problem – very seldom serious – they think I'm a genius. Now, I don't mind, you understand – this kind of thing would be good for the ego of *any* 17-year-old. But there was a time recently when I thought my reputation was really going to get me in a jam: My own father brought me an electronics job to do.

Now, I don't know how it is with *your* dad, but mine, unfortunately, is pretty hard to fool. He doesn't sit around the house every night building repeaters and things any more, but he does write an occasional book about some field of electronic endeavor; and he *is* the editor of a fairly famous ham magazine. When he told me about the project he had for me, I was pretty up-tight – even though I exhibited only the bravest show of confidence to him.

He handed me a large box of miscellaneous electronic parts and said, "This is a Heathkit frequency counter in kit form. Read all the instructions and put it together for me." He asked me to take notes on any problems I might have and jot down anything that I thought ambiguous in the step-by-step instructions; then he just left me standing there with my mouth open.

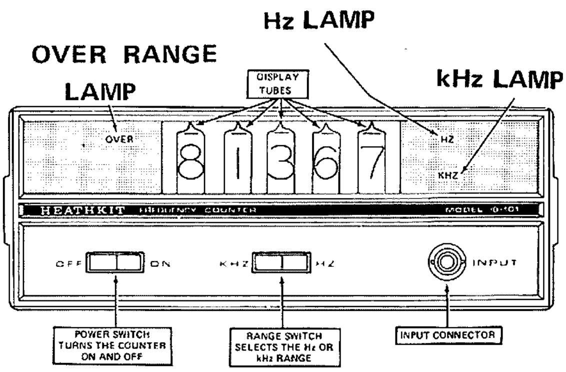


Fig. 1. Panel layout of Heath counter.

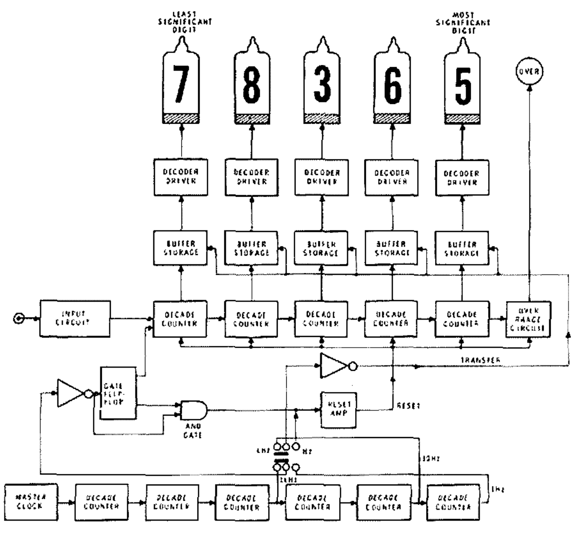


Fig. 2. Block diagram of Heath's IB-101 fre-

Well, I closed the doors to my room and gathered all my tools around me at my desk. It was Friday afternoon . . . a little past five. I opened the "tips and hints" book that comes with every Heathkit and thumbed through it. Most of the advice given here was pretty old hat to me so I decided to start right in on the counter.

I figured to work for an hour or so on the kit before cutting out to a movie with my brother. Boy, did I ever figure wrong! Kit-building is rather like eating potato chips; it's as impossible to work for a few minutes on a kit as it is to be content with munching just one lone salty cruncher. If my mother hadn't used her very effective form of coercion, I wouldn't have even broke for supper..

After dinner I was back at it again. I was soldering components to a double-sided epoxy-glass PC board, and I was almost ready to mount the IC sockets. So far, the job looked very professional, in my none-too-humble opinion. And I doubt if my father could have done as well (he's very old, you understand – in his late thirties – and his hands shake with the typical senility of his generation).

I finished the job about two in the afternoon, next day. I stopped for a short nap early in the morning after breakfast and again for an hour or so at lunch time.

The only thing remaining to be done at noon was the connection of the primary power cord, final checkout, and a calibration procedure that looked pretty simple. The kit had taken about 18 hours to complete, I estimated, without hurrying or cutting any corners. My father tells me that a kit of this complexity would have taken many months to build a few years back, and it would have ended up the size of a Mack truck. You can pack a lot of electronic circuitry in a single integrated circuit!

The unit I put together is called the IB-101; it is a very compact and lightweight digital counter capable of reading frequencies from near dc to 15 MHz. And, according to the manual, the basic functions and uses of the instrument are like those found on the very highest priced frequency counters (needless to say, the Heath IB-101 is not high-priced).

In general, the counter has the overall appearance of simplicity, despite the complex circuitry and number of features. (See Fig. 1.) Five cold-cathode display tubes, an "overrange" lamp, and two range indicator lamps make up the entire readout lineup. The accuracy of the readout is assured by a crystal-controlled digital clock. A high-impedance input circuit presents minimum loading to the circuit you want to test, and automatic level triggering lets you make measurements without having to fiddle with controls and such. It's all pretty nice. The block diagram of Fig. 2 shows the operational arrangement.

A feature I particularly like about the IB-101 is the simplicity with which it can be calibrated. If you don't happen to have an accurately calibrated frequency counter around to check the Heathkit against (and chances are you won't or you wouldn't have bothered to buy the Heath in the first place), all you *really* need is any old AM broadcast radio receiver. All you have to do is tune in a station on the BC set and hold it near the oscillator crystal in the counter. Then you just listen for a beat note on the radio and adjust the calibrate control (frequency adjusting trimmer) on the IB-101 for a zero beat.

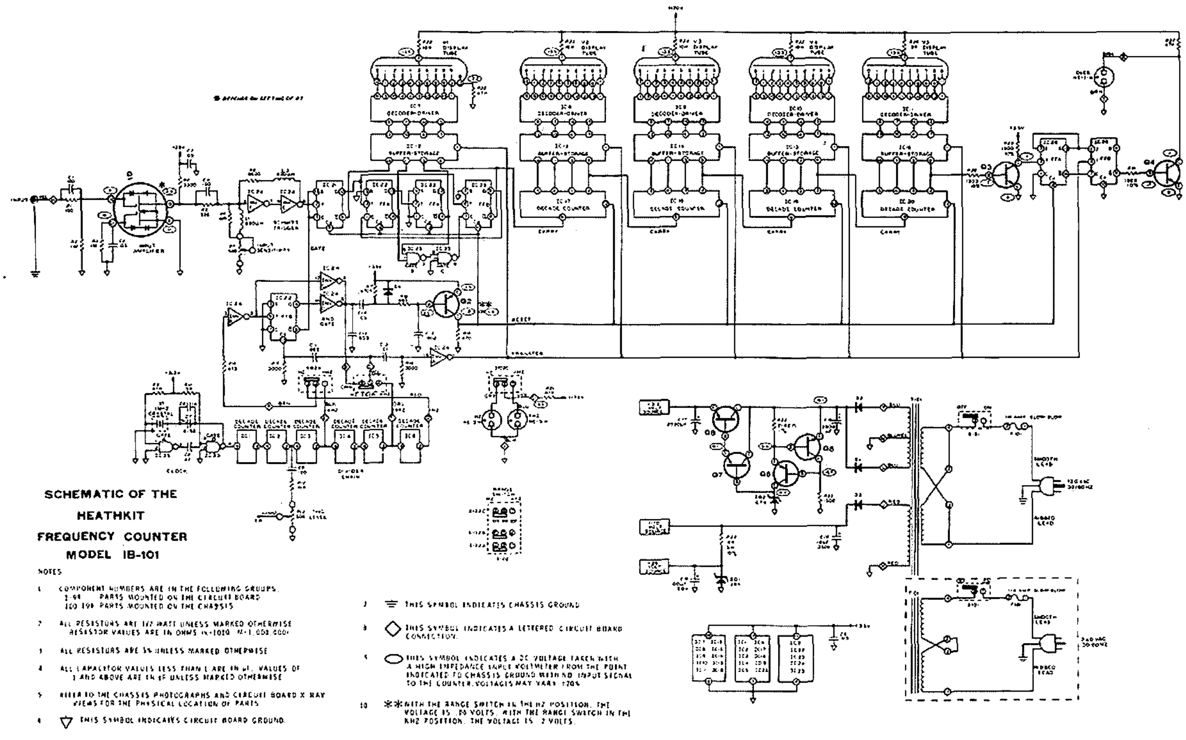


Fig. 3. IB-101 schematic diagram.

Even though there are only five digits readable on the counter, you are not restricted to reading out frequencies of that order. To count a frequency of 14.210450 MHz, for example, push the range switch on the counter to the kHz position and take a reading. The display will read 14210. Just keep this figure in mind and press the switch to the Hz position to read 10450. The overrange light will come on now to show that the frequency you're reading is actually higher than the Hz indication in the readout. Putting the two readings together gives the actual operating frequency: 14.210450.

The schematic diagram of Fig. 3 shows what the IB-101 is made of. The input amplifier and Schmitt trigger circuits accept and shape the input signal into a square wave. Decade counters change these sequential input pulses into a binary coded 8-4-2-1 output and recycle on every tenth input pulse. The four bits of binary coded information are then connected to the buffer/storage units which accept and store the count data on command of the transfer signal. The decoder drivers translate the binary coded information from the buffer/storage units into decimal form and drive the proper display tube cathodes. Timing signals for gating, transfer, and reset are generated in the clock and divider chain. It's all quite neat, you'll have to admit.

My advice to builders of this useful little instrument would only be to follow these simple suggestions: Before starting to assemble the kit, be sure you know all there is to know about soldering and wiring. If you don't, you'd better break down and read the "kit-builders's guide" that accompanies the kit.

Because of the very small circuit-board space between some of the printed conductor material, you have to be extremely careful to prevent solder bridges. Play it cool and don't try to use a big gun or eighth-inch-diameter solder! Use the minimum amount of solder required to get the job done and use heat sparingly. You'll really need a tiny tip on your iron to do the job right; and Heath recommends using an iron of not more than 25W.

If, by some flaky fluke of fate, you don't happen to have a low-wattage, tiny-tip iron, you can adapt a normal-size iron to the task: Be sure your iron is cool, then wrap a hunk of 14-gage bare wire around the tip as shown in Fig. 4. You can file the end of the wire to a sharp chisel edge, giving you the equivalent of a low-power iron. The only hassle with this approach is that the wire does tend to loosen after awhile; and it always seems to come loose at the wrong time. Irons are relatively cheap, though. So if you aren't also, your best bet is to get an iron tailored for the job. Who knows – you might want to build another kit one day, then at least you'd be prepared in advance.

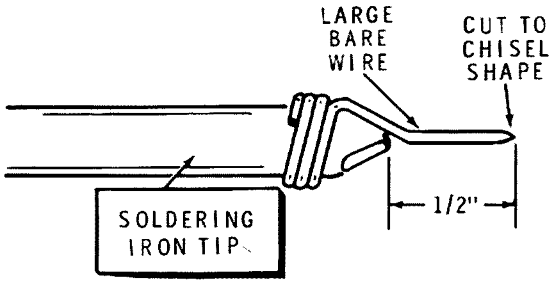


Fig. 4. Poor man's low-wattage iron: Wrap a piece of 12- or 14-gage solid copper wire around the tip of your regular iron, letting the wire end protrude a half inch or so. File the end of the wire to shape.

The counter is accurate – or at least it seems to be. Like all counters, the inherent error is plus or minus one digit in the least significant column (regardless of range) – and you could hardly kick about that.

Mr. Green is using the counter I built to check against the dial on his National NCX-1000. And he tells me that the National dial and the Heath counter agree consistently. All of which says a great deal for the National transceiver, too.

. . .Sessions■

LOW COST TRANSISTOR POWER SUPPLY

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23550 Whittaker
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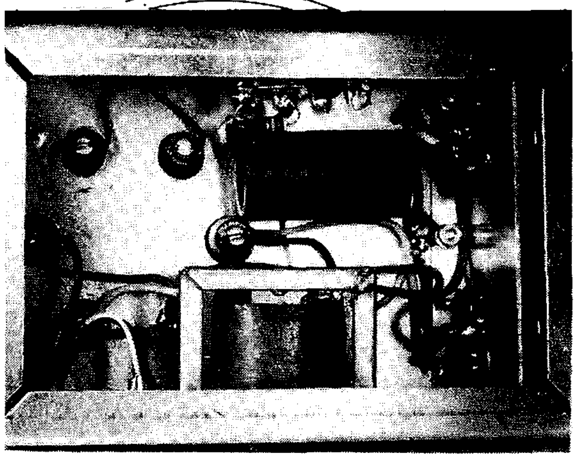
If you want to take your Twoer or Sixer mobiling or on Field Day next year, you'll need a 12V power supply for it. As Heath no longer lists the vibrator supply in the catalog, homebrewing becomes necessary.

This article describes the operation and construction of such a transistorized power supply. It is easy to build, compact, efficient, hash-free, and best-of-all, inexpensive. Parts cost, even without a well stocked junkbox, is only around $10.

The circuit (see diagram and illustration) is a novel one which was inspired by an article in *Electronics* magazine.[1] It prevents any switching transients from occurring, thereby removing this cause of transistor failure. The reason for this is the fact that the feedback transformer (T1) secondary is equally loaded through all parts of the switching cycle. Reverse voltage on the base–emitter junction of the "off" transistor is limited to the diode (D1 or D2) voltage drop across it. This allows use of inexpensive 2N3055s, which have emitter-to-base breakdown voltage ratings of 7V. These transistors, which are available very reasonably have collector current ratings of 15A maximum, so no large heatsinks are required.

The main power transformer (T2) is a dual-winding 6.3V filament transformer. The secondary windings are used as the primary and vice versa.

After much experimentation, it was found that a small 115-to-24V 250 mA unit made a good feedback transformer (T1). When connected as shown, it furnishes more than enough base current to insure driving the 2N3055s into saturation, providing low switching losses and good efficiency. Measurements indicated 315 mA of base drive per transistor. According to specifications, this is sufficient for switching 9.45A amperes collector current, assuming a minimum beta of 30.



Transistors are mounted on the L-bracket at right, along with diodes D1 and D2. Diodes D3 through D6 and resistor R2 are mounted on a tie-point strip at top center. Power cable enters at lower left, and C1 is not visible, being covered by lower left chassis lip. R1 is connected between a single tie-point strip and the base terminal of the upper transistor socket.

Resistor R1 provides a small base–emitter forward bias. As the secondary dc resistance of T1 is only 8Ω and small by comparison to R1, it is not necessary to bias each transistor with a separate resistor.

Imbalance is immeasurable.

Capacitor C1 helps filter out any transient spikes appearing on the 12V line. The secondary circuit is a conventional bridge rectifier and filter setup which furnishes about 210V under transmit conditions. Because the original Heath vibrator pack furnished 250V under the same conditions, a 330Ω 5W resistor was used in the Twoer (R14) to reduce it to 225V. To bypass this resistor, move the wire connected to pin 5 of the Twoer octal plug from the junction of D3, C32, and R14 to the junction of R14, C33A and R15. This will result in less power loss and proper operation from the lower power supply output.

This same circuit can be used with regular 12V vibrator transformers, making cannibalization of an old car radio worthwhile to obtain a suitable power transformer.

Owners of earlier FM gear using vibrator supplies can transistorize them inexpensively, gaining efficiency and reliability in the process. Just remember to provide

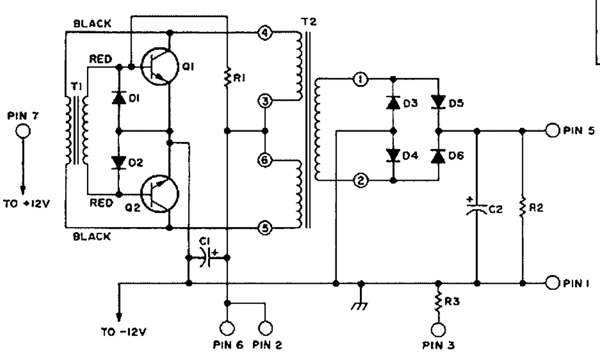


Fig. 1. Schematic diagram of power supply. The pin numbers refer to those in Twoer, and may be ignored if supply is used for FM receiver.

adequate transistor heatsinking, if you plan on making a 100 or 200W supply, for example. The circuit will also provide an ideal receiver supply for 450 MHz FM'ers who want to "duplex" their surplus mobiles.

About the only difficulty which might be encountered in the construction of this supply is its failure to oscillate. Should this happen, merely reverse *one* set of leads on the feedback transformer.

Don't worry about overheating *either* transformer. I have run this supply at *full load* for 4 hours continuously, and neither of them became even warm. Uncle Sam must have rated T2 very conservatively, and I'm sure it would withstand the continuous usage of a Field Day weekend without difficulty.

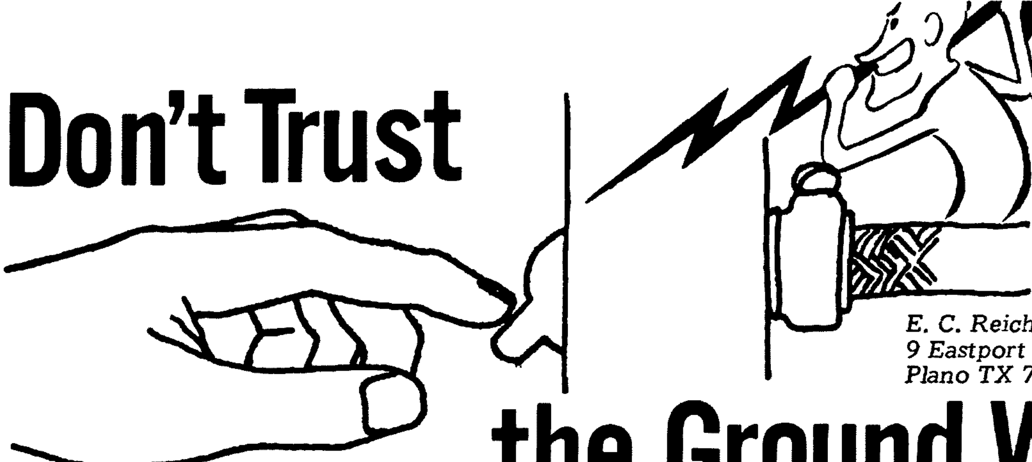
Parts List

T1	=	115V to 24V 250 mA (Fair Radio MW#4528)
T2	=	115V to 2/6.3V 1.2A (Fair Radio #7629809
D1, D2	=	silicon diode, 1A 50 PIV or more (Poly Paks)
Q1, Q2	=	2N3055 (Poly Paks)
D3, D4, D5, D6,	=	silicon diode, 1A and 400 PIV or more (Poly Paks)
C1	=	100 μF 25V electrolytic
C2	=	20 μF 350V
R1	=	1000Ω
R2	=	470kΩ
R3	=	150Ω

1. Roy Hartkopf, "Diodes prevent power loss and burnout in converters," *Electronics* September 14, 1970, p. 103.

W8AUR■

Don't Trust the Ground Wire



E. C. Reich, III W5FQA
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Equipment with a 3-wire (grounding) plug is too often regarded as being safe; but don't be fooled. Even though the equipment may be safe, the wires connecting power to the outlet may be defective, resulting in that safe ground wire connecting you directly to 120 volts, and maybe even a one-way ticket to the grave.

Last week my wife was walking down the carpeted hall in our two-year-old home when I asked her to turn off the light in the study. She reached inside the study door to turn off the switch while still walking in the hall. Her hand touched the screw holding the plastic protective plate over the switch simultaneously with her bare foot contacting the metal strip used to hold down the edge of the carpet. The result, a loud OUCH!

I promptly got out the voltmeter and played electrical detective. The meter indicated 120 volts between the metal strip and the screw in the outlet box containing the light switch. I suspected leakage, but when a 60-watt 120-volt lamp lighted to full brilliance, all doubts were removed. I connected a long wire from the cold water pipe in the kitchen to one lead of the meter. Then I checked every switch and outlet in the house. Sure enough, seven 3-wire receptacles and two light switches were connected with 120 volts on the metal outlet box. I checked the breaker box and found that all of these outlets were on the same circuit.

The cover plates were removed and the wires were disconnected one by one with an ohmmeter check being made after each was removed. The result was that the hot 120 volt wire in one of the outlet boxes in the study was stripped back about a half inch too far and when the outlet was installed in the box by the electrician the bare hot wire contacted the normally bare ground wire. Normally, this would have only resulted in a tripped circuit breaker; however, in this case, the ground wire in one outlet was wrapped loosely and the poor connection resulted in the ground wire burning in two at that point. This left the majority of the outlets on that circuit with the ground lead connected to 120 volts.

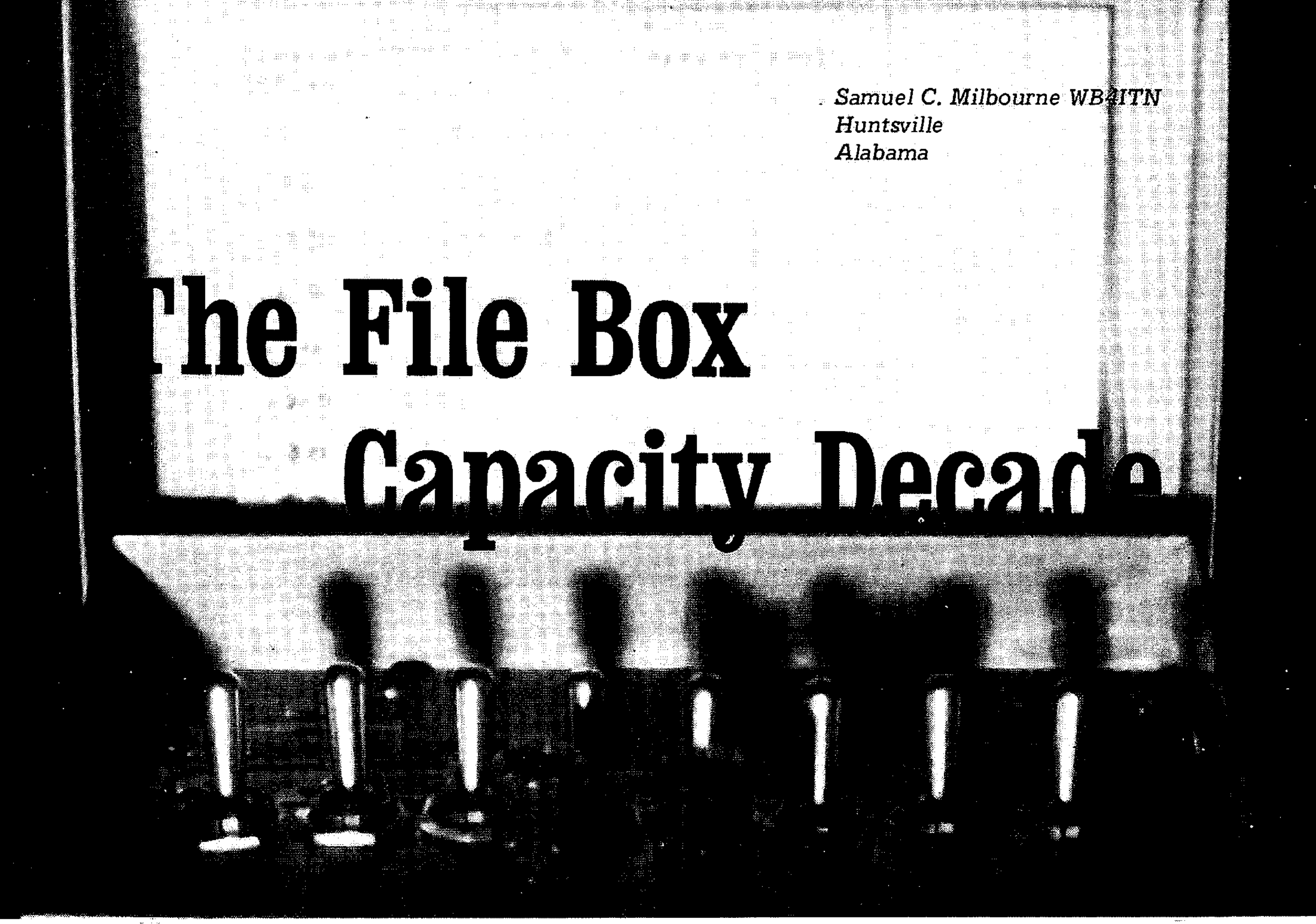
Just imagine your rig plugged into that outlet and you outside holding a piece of coax standing in a wet flower bed knowing you are safe because of the grounding plug. Then you grab the coax connector. . . ! Sure, our safety practices say we should ground the rig and remove power under these conditions; but, do YOU?

This incident is just one of many involving discovery of an electrical problem by my wife. Yet, she says she is not electrically inclined. When we first moved in, she was waxing the den floor before moving in the furniture. She reached up to adjust the chandelier and *******OUCH! Since we had not signed the final papers for the house, we called the builder and he sent the electrician over the next day. No one was home and he couldn't find anything wrong. He asked our nextdoor neighbor if she was familiar with the problem and she suggested he take his shoes off to duplicate the conditions my wife was working under. (It is surprising how much ham gear can be bought with shoe money.) Needless to say, after a shocking experience, he found a short in the fixture and no ground connection.

You may ask, how do these things get past the building or electrical inspectors? In Plano, like many other rapidly expanding communities, the inspectors just do not have time to check every detail and outlet. Certainly, you could sue if a member of your family were injured; but no one likes to be dead right! Many progressive cities, like Plano, have adopted modern standards requiring the 3-wire grounding receptacles in all new construction, while others only require the grounding receptacles to be installed in outdoor locations or laundry rooms.

In summary, it would be time well spent for you to check all outlets in your home to insure a proper ground. To do this, use a 120 volt, 60 watt lamp with one lead connected to a waterpipe ground. Using the other lead, check each outlet box and each terminal of the receptacle. Note the location of the hot terminal of each outlet. Then, check from the hot wire of each outlet to the outlet box to determine if the box is grounded properly. The lamp should light on only one terminal of each receptacle when one lead is connected to the waterpipe. If it lights when connected to an outlet box or grounding terminal of the outlet a serious problem exists. The lamp must light with one lead connected to the hot lead and the other lead connected to the outlet box or ground (120 volt return). If it does not, you do not have a proper ground connection to the box. Keep in mind that, if you live in an older home, you may not even have a ground lead in the wiring, other than the 120 volt return wire. To determine if you do have a ground wire, remove the outlet cover plate and count the number of leads in each cable entering the box. If each entry to the box has only two wires and metallic sheathed cable is not used, chances are you do not have a ground. (Metallic sheathed cable is seldom used in residential wiring.) If the outlet is of the 3-wire type and you do not have a ground in the wiring you are flirting with danger if you depend on the ground for protection.

W5FQA■

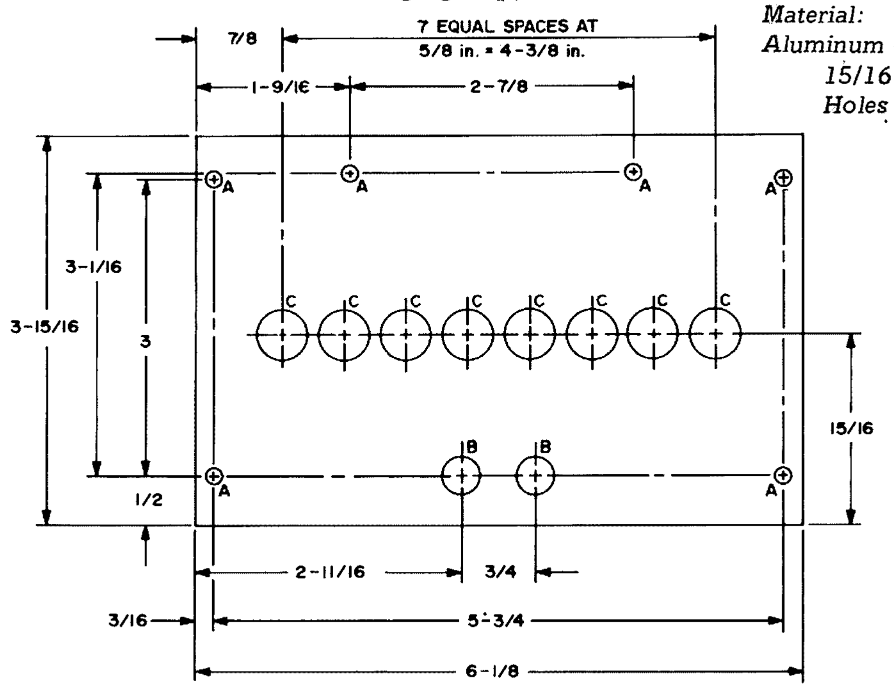


Samuel C. Milbourne WB4ITN
Huntsville
Alabama

The File Box Capacity Decade

In several previous articles, a compact, economical way to package many small test equipment circuits was described. This month we will consider capacity decade circuits, which can be packaged in a less-than-a-dollar 4 x 6 x 4½ in. file card box. This box has a swinging top, and is usually painted green or gray.

This, together with 1/2 x 1/2 x 1/16 in. aluminum angle, four rubber mounts, a 6 1/8 x 3 15/16 in. aluminum panel and mounting hardware complete the packaging parts list which is detailed later in the article.



Material:
Aluminum – .030 in. thick x 6 1/8 x 3 15/16
Holes – A *( ) #25 drill*
B *( ) 3/8 in. drill or punch*
C *½ in. drill or punch*

HOLE CHART		
SYM	SIZE	QTY
A	NO. 25 DRILL	6
B	3/8 in.	2
C	1/2 in.	8

Fig. 1. Panel layout .01–1.0 μF decade capacity box.

Mounting the feet and cards

Mount the four rubber feet on the bottom of the box. Position them ½ in. in from each of the four sides. This will allow a space 3 x 5 in. within which a schematic can be mounted. A 3 x 5 in. file card will be fine. Draw your schematic on this card and cover with pressure-sensitive transparent film such as acetate or Mylar. Fasten to the bottom of the box with 3M (Scotchbrand) #400 double-coated tape having adhesive on both sides or Goodyear Pliobond glue can be used to glue the card to the box bottom.

Brackets

Mount the two brackets by drilling two holes on each end of the box, 2½ in. from the box bottom and 2 in. apart. This will allow 1 in. between one hole and the box front. Use a #25 drill. Draw a horizontal line on each bracket, about ¼ in. from the bend in the bracket. Place each bracket inside and against the side of the box. Spot the line through the holes. Mark little circles on the bracket. Drill these four holes using a #35 drill. Slowly tap them with a 6-32 tap (use a light oil on the tap). Attach brackets to the box using (4) 6-32 x ¼ in. machine screws.

The panel (along with other holes for parts) will have two mounting holes on each panel end. See Fig. 1 for panel holes. Place the panel in position and mark circles through the panel holes and on the brackets. Drill with a #25 drill and tap with a 6-32 tap. Finally, attach the panel with 6-32 x ¼ in. Phillips-head screws.

Preparing the panel

The blank panel should be prepared for layout by attaching to it a 4 x 6 blank card. Use library paste or flour and water. The layout can then be made on the card,

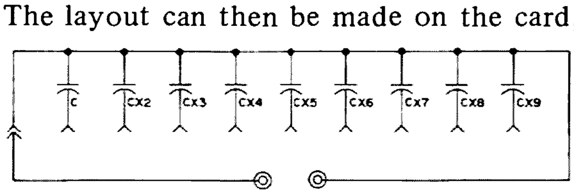


Fig. 2. Basic capacitor decade circuit where C is any value such as 0.001 µF, 0.01 µF, etc. and the remaining capacitors are multiples of C.

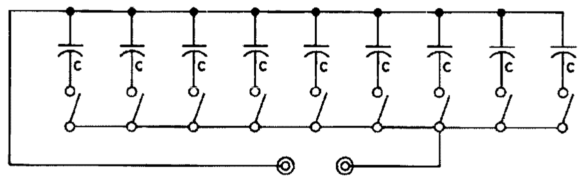


Fig. 3. Basic capacitor decade circuit where all values of capacity are the same, and one to nine switches are thrown to make up the desired value.

the panel drilled or punched out and finally, the card removed by soaking for a minute in hot water. The panel should then be cleaned thoroughly on both sides by using steel wool. A coat of zinc chromate should then be sprayed on both sides. Better, spray two light coats and steel wool between coats. Clean with alcohol to remove any steel particles or dirt. Finish with two light coats of your favorite color lacquer. A semigloss gray such as an RCA #222627 Light Umber Gray lacquer is my preference. If the panel is laid out symmetrically, you can pick the best side for the panel top.

All titles are in embossed tape. I use ½ in. tape, but ¼ or 3/8 in. tape is adequate.

Basic capacity decade circuits.

Figure 2 shows a basic individual-value capacity decade where each capacitor equals *C*, *C* x 2, *C* x 3, etc., *C* being the smallest value of capacitance in the decade. This configuration requires nine values per decade and, unless patience and a large quantity of each value capacitor is available, it is not recommended.

Figure 3 shows a capacity decade circuit composed of 10 individual capacitors, all having the same value. This requires only one basic capacity value against which all others are matched. However, it requires nine capacitors and nine switches per decade. Also, as many as nine switches have to be thrown (for *C* x 9) – a time disadvantage.

However, if you can obtain a quantity of precision capacitors of the same value, and the toggle switch inventory is high, this may be your circuit.

Personally, I am partial to the H configuration shown in Fig. 4. This uses only four capacitors mounted on a subpanel or swung between switches and a terminal strip. These values are *C*, *C* x 2, *C* x 3 and *C* x 4. If *C* and *C* x 2 are connected simultaneously (in parallel), they will equal C x 3. All connected, they equal *C* x 10.

Figures 5 and 6 show two dual-decade capacity boxes using eight electrostatic capacitors in one and seven electrolytic capacitors in the other. Note that in the first we have capacity values of *C*, *C* x 2, *C* x 3 and *C* x 4. Any value from *C* to *C* x 10 can be obtained by paralleling the correct capacitors. The second circuit shows a modified capacity decade using electrolytic capacitors. This circuit covers from 1 μF to 101 μF. These circuits also use toggle switches and can each be accommodated in a file box.

Note the calibration card in the lid of the file box. Calibration can be made at the finish of construction and at convenient times thereafter. Inasmuch as the circuit using electrolytic capacitors is not likely to be too accurate, no calibration card was included. Most electrolytic capacitors are marked with the value and the tolerance of minus 0% and plus 40%.

If you elect to build these two dual-decade file boxes, you will have a source of from .01 to 101 μF using only a total of 15 capacitors.

You will note that no working voltage has been specified for the capacitors. Obviously, the higher the working voltage the better. I have 400V capacitors in the .01–1.1 μF, and 250V in the 1.0–101 μF

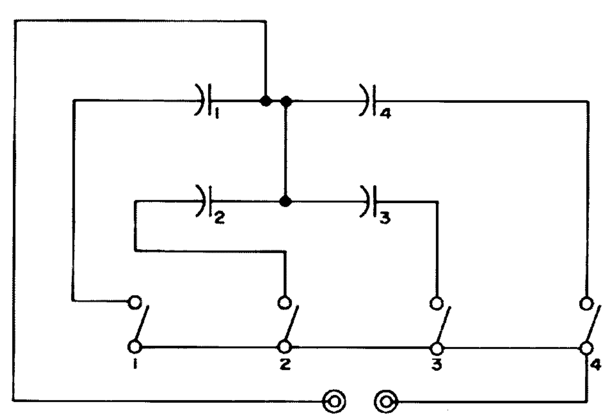


Fig. 4. H configuration capacity decade. The total output capacity is equal to the sum of the switches thrown (C x 10).

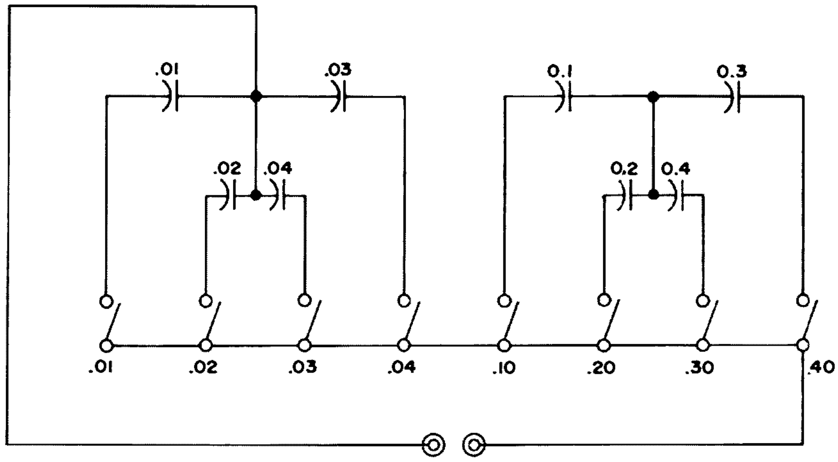


Fig. 5. Two-decade capacity box using only eight electrostatic (paper) capacitors and covering .01–1.1 μF.

decade units. There is room for up to 600V capacitors if desired.

When electrolytics are used, specify the plus and minus binding posts on the panel.

After mounting the switches and the 10-position terminal strip on the panel, the capacitors are mounted between one side of the toggle switches and the terminal strip. The other side of the toggle switches are connected together and to one binding post. The lugs on the terminal strip are connected together and to the other binding post.

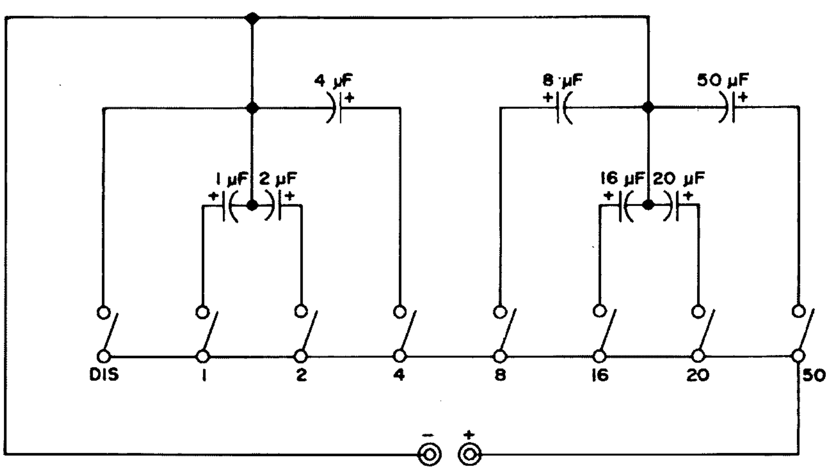


Fig. 6. Two-decade capcity box using only seven electrolytic capacitors and covering 1–101 μF. Note the first position marked "DIS" or discharge.

Figure 1 will show you my layout of the two decade capacity box panel. Be sure to check the diameters of the holes against the parts that you will use. For instance, there are two sizes of five-way binding posts, and you may want to use a different terminal strip with different mounting hole dimensions.

Parts List for File Box Cabinet.

(1) File box, 4 x 6 x 4½ in. Ohio Art Co.
(2) pcs. ½ x ½ x 1/16 x 4 in., alum. angle bracket
(4) Rubber feet with 6-32 mounting screws and nuts
(1) Panel, alum., 6 1/8 x 3 15/16 x .030 in.
(8) Machine screws 6-32 x ¼ in.

Miscellaneous Tools and Material

#25 and #35 twist drills
6-32 tap and holder
Fine steel wool
Alcohol
Zinc chromate spray
Tape embosser and tape

Capacitor Type Dual Decade Parts List

(8) Toggle switches
(8) Capacitors
(1) Terminal strip 10-lug
(2) 5-way winding posts
(2) 6-32 x ¼ in. Phillips screws and nuts

Capacitor values for .01–1.1 μF decade box

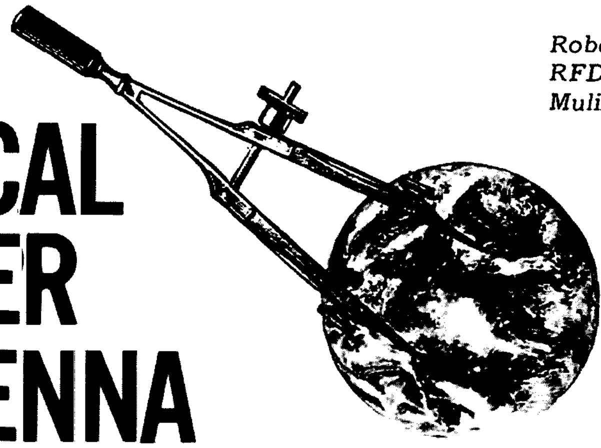
(1) ea. .01, .02, .04, 0.1, 0.2, 0.3, and 0.4 μF

Capacitor values for 1–101 μF decade box

(1) ea. 1, 2, 4, 8, 16, 20, 50 μF

. . .WB4ITN■

A PRACTICAL 40 METER DX ANTENNA



Robert N. Morris W7JLU
RFD 1 Box 273-U
Mulino OR 97042

Here is an inexpensive and rather simple DX array for the serious low frequency DXer. This antenna is called a Bruce antenna. It was sometimes used for point to point work in the late 1930s, but has never been extensively used by amateurs.

A Bruce antenna can be built utilizing nearly any single piece of wire of sufficient length since it will only be necessary to make the measurements and bends in the wire. In this system, as seen in Fig. 1, each vertical wire is in phase, whereas the horizontal portions are electrically out of phase. This can be determined due to the horizontal portions being tied end to end and that on any simple half-wave antenna there appears at each end the highest radio frequency voltages. Therefore the antenna radiates broadside to its line of radiating elements and the radiated signal will appear at a distant receiving point, as shown in Fig. 2. This will show that the energy from one of the vertical radiators will arrive nearly as soon as the energy from the others at the DX receiving point. If the receiving point is too far off of the antenna effective beamwidth, the signal will be weak. If the receiver is placed exactly inside the beamwidth, it will be seen that the energy will arrive at the given DX point simultaneously thereby giving a much stronger reception of the transmitted signal. This can be seen in Fig. 3. This antenna will give about 1 dB of gain for each two vertical elements in the system. My own 5-element Bruce gives an honest 4 dB. With this antenna pointed on Japan it is hardly possible to copy a VE7!! Also with this type antenna using up to five

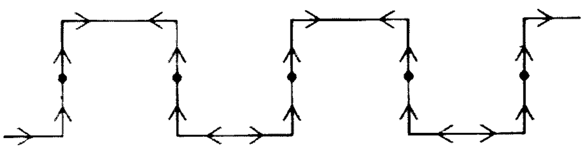


Fig. 1. Critical elements of line. Dots show current points; arrows show phase relationships.

vertical elements, no secondary lobes have been observed. Apparently the Bruce, while not having as much "published gain" as wider-spaced arrays, has less phase shift and internal problems as some of the others. The beamwidth of the five-element antenna appears to be only about between 15 and 20 degrees and the vertical polarization seems to give a slightly lower angle of radiation than a standard groundplane array such as utilized in AM broadcasting. This can be due to a current point higher above the ground. The antenna should be placed at least 8–12 ft above ground, since very high rf voltages at the center of the horizontal coupling sections can be dangerous. If any reader has had the experience of a high-voltage arc off the end of a voltage antenna point, this becomes very easily understood.

Constructing the Bruce Antenna Array

Fig. 4 shows the five-element Bruce. If space is a problem, you can make up a smaller array; of course it will sacrifice gain, but remember, this is *honest gain* This is gain over one vertical element and not over some theoretical isotropic type of antenna. The gain figures sometimes published by sly antenna salesmen are often misleading.

The dimensions of each section are shown. They are calculated from the

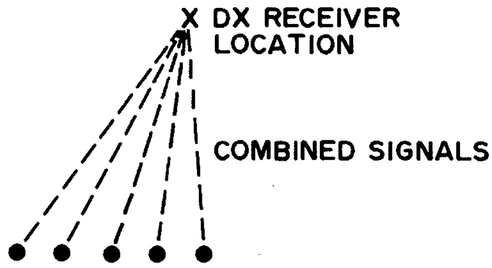


Fig. 2. Broad coverage area of Bruce antenna.

"stacked dipole" formula as can be found in such manuals as the Radio Handbook (Editors and Engineers). If several elements are involved, the dimensions are not too critical; but try to stay within the dimensions shown so the array will be self-resonant inside the band. When tuning the stub, any resonant discrepancy can be overcome by adding or subtracting slightly from the small horizontal end-fed portion. It would be well to note here that you can use the inexpensive galvanized electric fence wire sold by Sears and Roebuck for the entire antenna and feedline. Also the porcelain electric insulators for the feed system can be purchased at the same time. Be sure to use double lenghts (slightly twisted together) for the tie wires and for the horizontal top runs between insulators and be assured that the antenna will not come down in the wind. This wire will stretch very little and is durable. It can be soldered with no problem. Its size is #19 AWG and comes in half-mile reels for about $6. The small egg-type insulators should be used at the tie points as they have enough strength and insulation to effectuate the job. If the ends of the antenna are to be hung over high-enough tree limbs you can use the excellent hemp ropes (at least ¼ in. type) which can be purchased quite cheaply at surplus and farm supply stores.

The Open-Wire Feedline System.

For simplicity, let's construct your quarter-wave matching stub. For 40 meters this will figure out to require two pieces of wire 35 ft long. Make up a jumper wire for the outer end with alligator clips soldered to each end. Take eight of the electric fence insulators and four lengths of some kind of wood spacer about 10 in. long. This material can be pieces of 1 x 2 in. lumber. Nail the round edge of the insulators up against each end of these spacers on the wide side. This is an easy method and looks quite pleasing hanging up horizonally while not being heavy. This whole system using five vertical elements has withstood very high winds. You will find the whole system to be very light in weight. Use the strongest antenna insulators you have available for the top ends and hang up the antenna.

If you use more than three vertical elements, be sure it is exactly broadside to the DX location you wish to cover. Now no matter what they say the stub must be adjusted for maximum rf indication on any simple field strength meter.

Set up your meter somewhere between any two elements and place it far enough away from the antenna so that you can still be able to see its indications. The feedline is constructed just about like the stub (and I prefer the wide-spaced feeders). Nail on the insulators and place these feeder cross arms high enough above ground. Small trees will work fine. The 10 in. spacers are fine. and when the lines are attached and pulled tight it will be unnecessary to worry about the lines swaying and shorting together. My feedline is over 300 ft long and only supported every 75 ft or so. This feedline can be run off in *any* direction. Mine is 12–14 ft above ground.

Make your feedline any odd number of quarter waves in length and you will find a point where 50Ω coax can be attached at a current point and it will also be feeding an

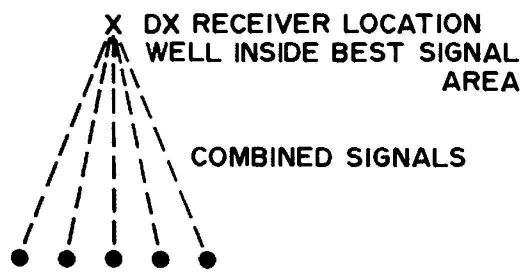


Fig. 3. Radiation from line of broadside elements.

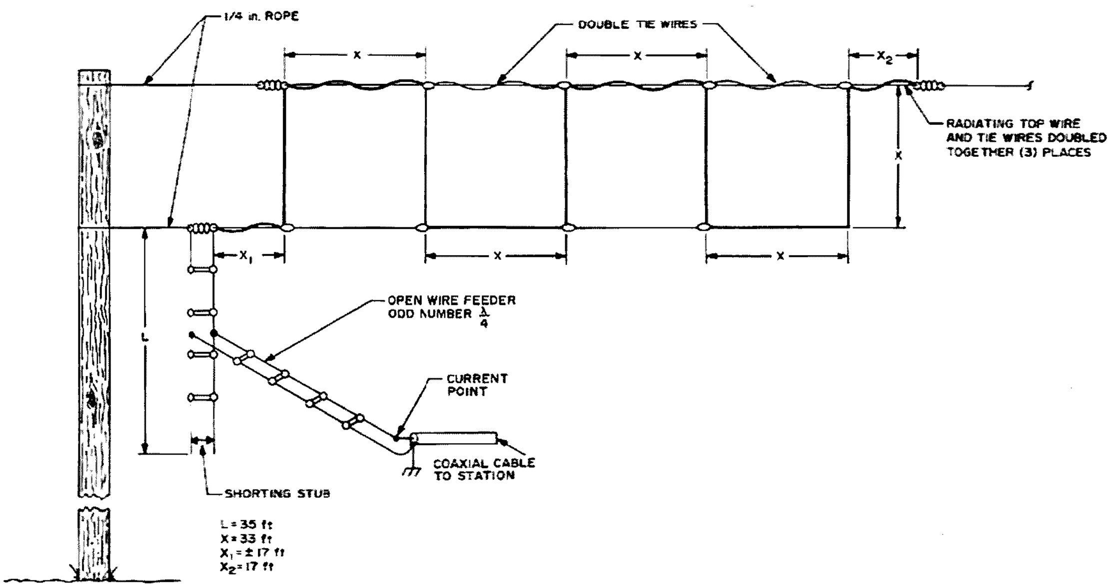


Fig. 4. Dimensions and layout of 5-element Bruce at W7JLU.

unbalanced system. This will only take a little trial and error and can be done perfectly well using a noise driven bridge (I used an Omega T Systems type). Before this input end is completed, however, place the shorting wire on the stub out from the antenna end to about 33½ ft. Then tap the open-wire feeders described or any other type of open wire feeders you may wish to use about one third of the way toward the antenna end on the stub from the stub end.

Tuning it up.

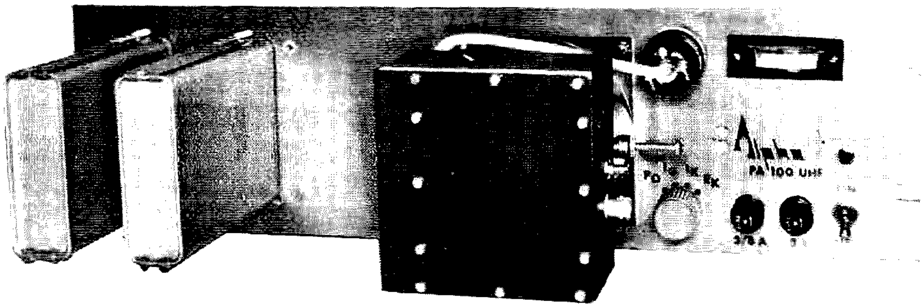
After hooking your coax at the current point, feed a couple of watts into the beam. Tune your transmitter to the portion of the band that you like best and preferably set up zero beat with some commercial broadcast station so you will not bother the other amateurs. Next, go out to the antenna on a stepladder and set both the stub and the feeders until you get the best signal as indicated on the field strength meter. I should mention here that alligator clips were also placed on the feeders at the antenna point. When you get the highest signal, solder (use a torch if possible), but be careful of overshooting the proper soldering temperature here. You can just solder the clips to the stub right where they are. Be sure to solder all four clips. It will only next be necessary to slightly readjust and possibly bridge your coax feedline at the transmitter output end of the line. In this case, the transmitter is shut off and you are using your station receiver as an impedance and null indicator.

Performance and Results

Using this antenna it is possible to work stations such as JAs several hours earlier than usual. Since the antenna is bi-directional the South American stations sound like locals, yet W signals are not too loud so it shows a very worthwhile low angle. Opening the antenna at the third element made it possible to contact UAO in zone 18 and KG6 – both at an early hour so the effective beamwidth seems to sharpen up with more than three elements. With tests with W7CAL in Arizona the antenna showed around 20 dB difference just off its beamwidth as compared to another curtain favoring that particular direction. Stations coming in from off the end of the array being picked up on another curtain on the North Pole usually completely disappear when the Bruce is switched on. Thus, I can assume that the horizontal portions are very ineffectual – even on signals arriving from a high angle. The signal from W7MVC located about 35 miles off its end dropped 30 dB as compared to another curtain operating in that direction, using a Drake R4-B S-meter.

W7JLU■

a commercial bid for the 450 market



With 2m FM repeaters being the "in" thing these days, you might well wonder why a manufacturer would bother marketing an amplifier designed for the 450 MHz band. But have you ever stopped to think that behind nearly every 2m system there's a 450 MHz repeater? It's true. Those fellows who install their VHF repeaters can't do it without some form of control, either by a wireline or by some frequency above 220 MHz. Since wirelines are expensive, and little gear is available for 220 MHz operation, the 450 band gets the action.

But the 450 region is used for a great deal more than accessing 2m and 6m repeaters. Many groups install their own "closed" repeaters operating exclusively on 450. And many more have 450 repeaters serving as remotely controlled telephones, access repeaters for remotely operated base stations, and repeater-to-repeater links.

So it is not surprising that some enterprising manufacturer has made available a fairly high power 450 MHz class C amplifier designed for unattended operation at remote locations. Alpha's PA-100-UHF is it. The amplifier is capable of delivering 100W into a 50Ω antenna with a lowly 10W of drive required.

The manufacturer, Alpha Electronic Services, Inc., 8431 Monroe Ave., Stanton, California 90680, is not producing these amplifiers exclusively for the amateur remote/repeater crowd, incidentally. The UHF amplifiers complement the firm's line of tone encoding and decoding equipment, all of which are quite popular with commercial radio users occupying the spectra adjacent to the VHF and UHF amateur bands. It's just that the company's decision to open their marketing to include the amateur was only recently formulated.

Although designed to operate in the 450–470 MHz range, 73 found that no modification was required to get the amplifier perking as low in frequency as 440 MHz. With approximately 12W of drive from a sick T44, the amplifier kicked out a signal that exceeded 125W, as measured on a Bird Thruline wattmeter.

The PA-100-UHF has a self-contained power supply (solid state, of course) that incorporates no moving parts (no relays, yet). It is designed for rack mounting, and requires slightly more than 5 in. of panel space. The simplicity of its design, couple with the "unitized" construction of its major components lends itself nicely to plug-in interchangeability, too – a factor that is quite attractive when the remote location is a long way from home and in an isolated area.

The amplifier consists of a grid input chassis, a tuned coaxial plate cavity, and the power supply. The power supply is itself built as an integral part of the rack panel. The plate cavity and the grid input chassis are mounted to each other and the assembly is mounted to the rack panel. The switches, fuses, pilot light, tuning controls, meter, and input and output connectors are all accessible from the front of the cabinet, simplifying tuneup, checkout, and testing operations.

Power Amplifier

The power amplifier itself is an ac-ground cathode, grid driven, power tetrode. Since the plate of the tube is designed for conductive cooling, the dc power supply voltages have been inverted to take maximum advantage of this feature. This has been accomplished by making the plate of the tube a part of the center conductor of the coaxial cavity resonator that serves as the plate tank circuit. By inverting the power supply voltages, the plate is at chassis potential, therefore the entire cavity and associated mounting surfaces (the whole panel) are utilized as a heat-dissipating element, reducing hazard to the operator.

The grid input to the tube is a modified pi-coupled circuit chosen to absorb the grid lead inductance of the tube and to overcome the high grid input capacitance of the tube. The tube is operated class C, thus assuring maximum plate efficiency during operation and practically no idling current in the absence of a drive signal. Typical plate efficiency of the tube in this unique configuration is typically 60–65%. The high plate efficiency of the coaxial cavity assures maximum realizable useful power output under the power input limitations imposed by the FCC, and at the same time optimizing harmonic or spurious rejection.

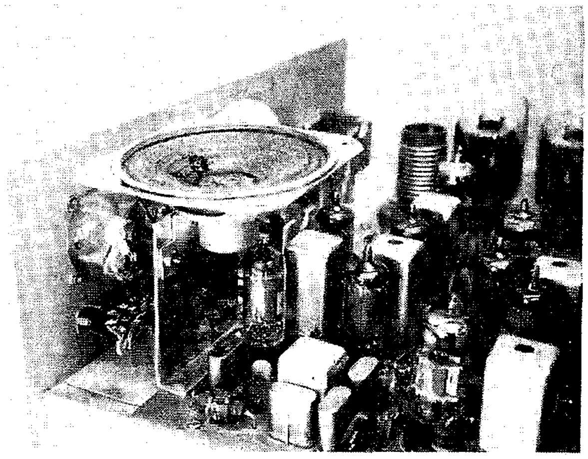
The dc power for the tube is obtained from conventional bridge rectified supplies. Screen grid voltage is derived from the cathode supply by the use of zener diode regulators.

In all, the PA-100-UHF was found to be very conservatively rated, more than living up to the published specifications – a moderately priced and very desirable piece of gear for the modern UHF man. . . .Staff■

Modifications to HW Transceivers

Bud Michaels WB2WYO
713 High Street
Victor NY 14564

Bracket mounts to chassis with screws holding down printed circuit board. Speaker can be mounted using pop rivets. The 6BE6 under the speaker can be removed without removing the speaker.



The Heath HW series of monobanders are really great! They can be used for mobile and fixed-portable use as well as in your home station. And with 200W PEP input, you can make a healthy dent in the QRM.

Two minor annoyances with these rigs are the need for a separate loudspeaker and the phono jack in place of a standard phone jack. You need an adapter if you want to use headphones. Happily, these two points can be easily remedied with no metal work or permanent alterations to the appearance of the unit.

I mounted a 3½ in. speaker on an aluminum bracket which in turn is bolted to the chassis using the same screws that hold down the printed circuit board. The speaker is located just behind the panel meter and has no effect on the transceiver or impairs the cooling in any way. The Utah line of "Microgap" speakers come with a convenient transformer bracket which makes mounting that much simpler. Connect one wire from the speaker to the ground lug on the pilot lamp assembly. Run the other wire from the speaker under the chassis, loosely wrapping it around the wiring harness to keep it out of the way. Use a piece long enough to reach the speaker jack on the rear skirt.

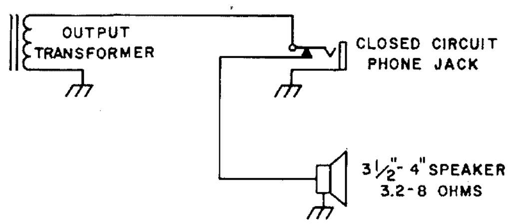


Fig. 1. Circuit diagram of add-on speaker arrangement.

A standard phone jack will fit perfectly in the hole for the speaker jack; no filing or drilling is necessary. Use a closed-circuit type jack so the speaker will automatically be shut off when you insert the headphone plug. You will find that by using low-impedance headphones, you can hear the weak stations much better than with the speaker.

. . .WB2WYO■

CW SELECTIVITY

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Dunedin, New Zealand

The 3.0 kHz crystal or mechanical filters now in general use for SSB reception generally have excellent skirt selectivity, but the nose bandwidth is too broad for satisfactory CW work under crowded band conditions. Undoubtedly the best solution is a commercial narrowband filter, but these are expensive, often hard to obtain, and may be difficult to fit into an existing unit. A parallel i-f strip or "Q-5-er" is a relatively clumsy and complicated method and the use of another mixer stage to get down to an i-f of 50 kHz or so adds to overload and cross-modulation problems. Filters at audio frequency are of limited help, as strong adjacent signals are still amplified before detection and by overloading punch holes in the desired signal.

A relatively cheap and simple solution is to follow the 3.0 kHz filter with a single crystal gate. This provides sharp nose selectivity while the 3.0 kHz filter helps with the skirt selectivity. The circuit shown uses no tuned normal conditions, is a few kHz higher in frequency than the series resonance. Overtone crystals will work in this circuit at overtone frequency.

Start by testing the circuit with the crystal switched out and the trimmer disconnected. Check that the electrode voltages are correct and that the stage is providing normal gain. Now switch in the crystal and slowly tune across the pass band, monitoring the i-f output with the existing S-meter or a VTVM. A rather poorly defined peak should be found at crystal series resonance. Tune to one side of this peak and connect up the neutralizing trimmer and adjust it for minimum output. Now sweep slowly across the passband once more. A very sharp peak should now be apparent. Continue adjusting the trimmer and sweeping the passband until you get a symmetrical peak. My crystal required 4 pF, but this value will vary for other crystals. Finally, tune to the crystal peak, switch the crystal

circuits and may simply replace an existing first i-f amplifier tube without any material loss of gain. In my case, a combination of a small Japanese HC 6/U filter crystal at 455 kHz following a 2.1 kHz bandwidth Kokusai crystal-mechanical filter gave a bandwidth of about 220 Hz at -6 dB, 600 Hz at -20 dB, and 3 kHz at -60 dB. Where the unit is incorporated into existing equipment the crystal can be switched out by a small relay or a low capacity diode switch. In a transceiver, where the first i-f stage is common to both transmit and receive modes, this relay or diode could be coupled with the normal transmit receive switching so that the crystal is never operating on transmit.

The triode stage acts as a cathode follower giving a little less than unity gain. Signals, at the series resonance of the crystal, pass through it and are amplified by the second stage, which is a conventional pentode amplifier. The small capacity from the triode anode neutralizes the parallel capacitance of the crystal and its holder, which would otherwise couple unwanted signals through to the second stage. Setting up the unit is simple, once you have obtained a crystal with its series resonance falling within the SSB filter pass band. Remember that most crystals are specified for parallel resonance, which, under

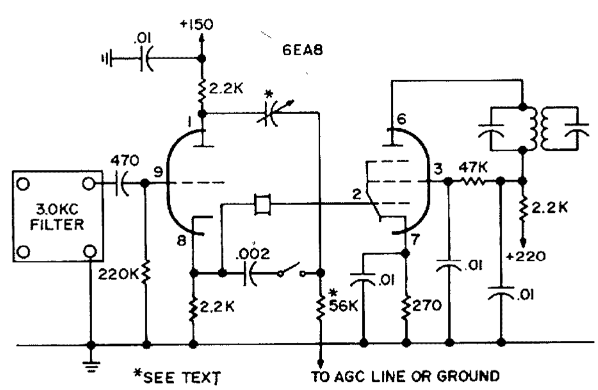

Fig. 1. A sharp i-f amplifier circuit for CW selectivity.

out and observe any change in gain. If the gain is lower in the 3.0 kHz position, decrease the value of the grid resistor of the pentode stage, or vice versa, until you have equal gain at both selectivity positions.

The degree of selectivity possible with the circuit described demands high stability at both receiving and transmitter ends.

If the other chap comes back with drift and chirp at fifty words per minute, you will just have to switch to 3.0 kHz selectivity to copy him!

to switch to 3.0 kHz selectivity to copy him!

. . .ZL4OK■

STUDY GUIDE GENERAL CLASS LICENSE

Part IX: Putting the "TELL" in "TELE"

While some of us might find it amusing for a little while to turn on a radio transmitter without transmitting any information, that's not really the purpose of ham radio. In fact, it's so far from the purpose that the broadcast of a raw carrier is prohibited by FCC rules (except briefly for test purposes) at all frequencies below the UHF region.

The real purpose of almost every radio transmitter we're likely to come across or operate is to transmit *information.* So far in this study course directed toward the General class ham ticket, we haven't bothered to look at how this purpose might be accomplished. Now we'll remedy that, and spend this chapter examining rather closely the why, what, and how of modulation.

In so doing, we will cover the following five questions from the FCC study list (numbers, as always, are those assigned by the Commission in their official list of study questions):

9. What is amplitude modulation (AM)? How is the intelligence conveyed in an AM signal?

19. What symbols does the Commission use to designate how the main carrier of a signal is modulated?

24. What is meant by percentage of modulation? What is the maximum legal limit to which an amateur transmitter can be modulated?

31. What is meant by the bandwidth of a signal? Compare the maximum necessary bandwidth occupied by a CW signal, an SSB signal, a double sideband signal, and an ordinary voice signal.

52. How is the bandwidth of an FM signal related to the bandwidth of the modulating audio signal?

These questions presuppose some knowledge of just what modulation amounts to, but we won't make that same assumption. Rather than dwell on the specific points raised here, we'll take a more general outlook and rephrase the questions into four others which cover the subject.

The first, "Just what is modulation?" will give us the background to understand the role of "modulation" in the transmission of information by any means, not just radio. With this established, we'll return to a more technical viewpoint and ask "How is it related to bandwidth?" The answers to this should provide all the ammunition necessary to handle questions 31 and 52. We will then concentrate our attention on voice communications and ask "How do AM and FM carry voice?" This question should take care of questions 9 and a part of 52, plus any variations which might be sprung as a surprise. Finally, we'll inquire "Why and how is modulation measured?" Here, we'll examine the rules and regulations governing modulation, as well as the techniques used to measure it.

Although we have only four questions on our revised list, they're all rather tough ones. Let's not waste time getting started.

Just What is Modulation?

If we were to look "modulation" up in a dictionary, we would find that it means (in general) "the act of modulating, or the state of being modulated." To modulate, continuing our search, is to "vary the tone, inflection, or pitch" or "to regulate or adjust, temper, soften." The word comes from the Latin "modulus" or module, which in turn comes from "modus" which meant "to measure." None of which, un-

fortunately, is of much direct help in determining just what modulation amounts to.

All these assorted definitions of "modulation" are, however, quite relevant to our purpose here. In communications, "modulation" is the variation of *any* characteristic of something, in order to convey information or "intelligence." The white paper upon which these words are printed could be said to be "modulated" by the ink which forms the letters, for the purpose of conveying this information to you.

The characteristic which is modulated may be almost anything capable of being varied, regulated, tempered, or measured. In radio, only three characteristics of a transmitter's signal are normally modulated, and normally only one of these three is modulated in any specific transmitter.

For instance, the amplitude or strength of the signal may be changed. A simple example occurs in a CW transmitter, where the signal is either full on (with the key down) or turned off (key up). This *is* a form of modulation, since it is a variation of the signal strength caused for the purpose of conveying information. Most folk (including the FCC), however, distinguish between AM and CW despite the fact that CW operation is a simplified form of amplitude modulation.

Amplitude is not the only characteristic available to be varied. We can, if we choose, keep the amplitude constant and vary the frequency of our signal. This is just as effective in changing its strength – in many cases, more effective. This technique is known as "frequency modulation" or FM.

The third characteristic which is frequently used for modulation purposes is the "phase" of the signal; the technique is called "phase modulation" or PM, but in practice is virtually indistinguishable from the FM technique since the frequency cannot remain constant as phase changes – which means all FM has some PM and vice versa.

Since all FM does have some PM, and vice versa, these two types of modulation are usually lumped together in engineering textbooks under the heading "angle modulation" (the "angle" referred to here is the "phase angle"). The FCC, however, has very little to say about PM in the amateur license exams; all the questions deal with either AM or FM.

For that reason, in this installment we'll deal with AM and FM. It'll be up to you to remember that in most cases, what we say about FM is also true of PM. In those rare occasions when this is not the case, we'll let you know.

So far, we have defined modulation as the variation of "any characteristic of something in order to convey information," and have identified three characteristics of a radio transmitter's signal which may be varied in order to modulate the signal. We then reduced the resulting three types of modulation (AM, FM, and PM) to only two for the purposes of this discussion (AM and FM).

That part of a radio transmitter's signal which is sent out in the *absence* of any modulation is called the "carrier wave." This name, like the British term "wireless," comes to us from the days of early radio when everyone thought that the purpose of the radio signal was to "carry" the information from place to place, just as the wires do in a landline situation. While we now know better (and have since 1927), the old name has persisted.

The carrier wave is the signal generated by the transmitter's oscillator and built up to strength by the amplifier (refer to the previous chapter for discussion of these parts of a transmitter). The modulator then controls either the amplitude or the frequency of this carrier wave, to produce the final radiated signal.

In general, this control process which does the actual modulation of the output signal adds something extra to the signal.

In the case of AM, the "something extra" is usually in the form of added power imparted to the signal. The exact amount of power added by a typical voice signal is almost impossible to estimate; engineers use a steady sine-wave signal instead of voice for measuring the effect, and the FCC expects to see the engineer's answer on the exam. With 100% (we'll get into percentage of modulation later) sine-wave modulation of a carrier, one half again is the amount of power added. That is, a 500W AM transmitter would be operating with 750W input during this type of modulation. The added power, being ac, does not show up on your input-power measurements, nor need it be included in your records.

With FM, the "something extra" takes the form of a frequency change in the

signal sometimes called "vanishing carrier." At certain specific levels of modulation with FM, the carrier wave literally disappears and all the power shows up at other frequencies in the immediate neighborhood. This vanishing point for the carrier is sometimes used to measure modulation levels for FM transmitters.

With any form of modulation of a carrier wave, sidebands are created. The unmodulated carrier is, just as closely as we can make it so, a single spot-frequency signal. That is, if we are operating at a frequency of 3.735 kHz, *all* of our output energy is at 3.735 MHz; none at all is at 3.735000001 MHz, or at 3.734999999 MHz, even though these frequencies are only 1/1000 of 1 Hz away from our chosen frequency. Of course, no known measuring technique can prove that this is the case, but it's what we are trying to achieve.

When we modulate, with a single-frequency tone, we introduce additional frequencies into the output signal which are known as side frequencies. If we apply AM, using a 1 kHz tone, one side frequency will be 1000 Hz higher than the carrier, and the other will be 1000 Hz lower. The first of these is known as the "upper side frequency" and the other is the "lower side frequency." They are also called sum and difference frequencies, because the upper side frequency is the *sum* of the frequencies of the carrier wave and the modulating signal, while the lower side frequency is the *difference* between the frequencies of the carrier wave and the modulating tone.

A man named John Carson developed the theory of side frequencies and "sidebands" (with voice rather than single tones, a whole band of frequencies is involved in the modulating process, and the side frequencies smear out to become sidebands) in 1927, and obtained a patent in that year for a system of radiotelephone transmission which made use of only one of the two mirror-imaged sidebands. Even though his technique worked, and was used for many years by the Bell System for transatlantic conversations, most people felt that it was a mathematical fiction and refused to believe that the side frequencies really existed. Development of accurate measuring apparatus in connection with radar's development in the years 1940–45 made it possible to actually see the sidebands in a scope display of a radio signal and proved their existence. Since 1948, single sideband has been an important technique of ham radio voice communications. While SSB is a special form of AM, it differs rather drastically from ordinary AM and so we won't talk about it any more in this chapter. Here, we'll look only at ordinary AM and at FM.

The sidebands do a bit more than merely making SSB possible. They cause the signal to occupy more spectrum when it's modulated than it does when it's not. That, however, is getting ahead of our subject, and means that we're ready to ask our next question.

How is Modulation Related to Bandwidth?

We observed, a few paragraphs back, that the *unmodulated* output of a radio transmitter is (to the limit of our ability to achieve the goal) a single, spot-frequency signal. Strange as this may sound, such a signal would occupy no space at all in the radio spectrum, because it would be present only at one single frequency.

The space in the spectrum occupied by an actual signal, on the other hand, is known as the bandwidth of that signal, and is measured in hertz or kHz just as is the signal's frequency. The bandwidth is determined by subtracting the lowest frequency in the signal from the highest frequency present; the resulting difference is the bandwidth of that signal.

Our example spot-frequency signal at 3.735 MHz would have both its highest and lowest frequencies equal, and their difference would be zero. That's why we say that such an ideal signal would take up no space at all.

However, one of the lesser-publicized researchers into communications discovered that such a signal, while it might occupy no space at all, would be rather useless because it could not convey any information either! The man who made this discovery was also involved in circuit design, and his name is more familiar to most hams in connection with an oscillator circuit he derived, but Hartley's Law relating information rate and bandwidth is probably more important because it sets an absolute limit on the amount of information which may be sent in any specific portion of the rf spectrum.

The law itself is simple: the bandwidth required to transmit information is directly proportional to the information trans-

mission rate. To see why this is so, it's easiest to look at a simple case involving only one item of information such as presence or absence of a carrier wave. This is known in *information theory* as one "bit" of information.

If we need not know whether the carrier is on or not more often than once every second, and look at it no more frequently than this, then it would be sufficient to turn it on for a full second and then leave it off for the next second. This would be an information rate of one bit per second, or one "baud." The baud is a unit of information transmission speed, named for Georges Baudot, the French telegrapher who invented the 5-unit teleprinter code used in radioteletypes.

Going further, we could represent this one-baud information rate by a sine wave with a frequency of 0.5 Hz because one bit of information would correspond to each half-cycle of the sine wave.

This sine wave could not, however, tell us anything about events happening more often than once per second. If we wanted to know conditions 20 times a second (an information rate of 20 baud), we would have to look at things 20 times more frequently, and the lowest-frequency since wave which could carry this information rate would be one of 10 Hz.

To carry information at a rate of 200 baud, we would have to increase the frequency of the sine wave to 100 Hz, and to get up to 2000 baud, we would require a frequency of 1000 Hz. That is, the frequency is always half the information rate, according to Hartley's Law.

This is, however, the theoretical limit, and has never yet been achieved in a practical system. Even more frequent sampling than Hartley's Law would indicate is required; to carry an information rate of 2000 baud in practice requires a sampling rate of 5000 Hz.

Now let's go back to "sidebands" and see what happens when we attempt to transmit our information, using the corresponding sine wave (and the frequencies determined by Hartley's Law). Even with our theoretically perfect zero-bandwidth carrier wave, as soon as we put even a one-baud information rate onto it we create side frequencies 0.5 Hz either side of the original, so it now has a bandwidth of 1 Hz – just the same as the baud rate of the information. If we attempt to transmit

information at the rate of 2000 baud, we will have a signal with a bandwidth of 2000 Hz, 1000 either side of the carrier.

What this means in practice is simply that even were we able to achieve a "perfect" zero-bandwidth carrier, just as soon as we add modulation to it to convey information it will require sidebands. These sidebands must be large enough (wide enough) to "carry" information at the rate we are pumping it in.

And if you think this is just an exercise in doubletalk, then fire up a supersharp receiver, crank its selectivity down to a needle-sharp 10 Hz or so. (It can be done, with a good crystal filter together with a Q-multiplier and a sharp audio filter – ask any serious VHF man.) Then try to copy some of the 100 wpm CW that shatters the airwaves down around the low end of 40 meters. You'll find that the dits and dahs all run together into a solid tone. We normally say that the filter is "ringing" in such a situation, but what's really happening is that the sharp filtering is shaving off the sidebands which carry the 100 wpm information, leaving you only the carrier.

When we deal with phone signals and ordinary voice modulation we don't speak of "baud rate" or "bits"; these terms are more often encountered in commercial telegraphy and the computer industry (where they are standard) than in radio to begin with. The principle of Hartley's Law still applies to voice communications, however. Through experiment (mostly by the telephone people over the years) it has been determined that the normal frequency range used for voice communication is from 300 to 3000 Hz, which means a bandwidth of 2700 Hz.

This means that for normal communication, each of our sidebands extends from 300 to 3000 Hz away from our carrier frequency, giving us a total bandwidth for normal AM of 6 kHz (from –3000 to +3000 Hz).

We don't get this automatically, though. The voice contains frequency components ranging up to 15 kHz, and if we go for "hi-fi" or "broadcast quality" communications, we will take up 30 kHz of the spectrum instead of 6. That's five times as much space as we need, and means that we stand to create five times as much interference to other stations. For this reason, it's considered good operating practice to restrict the frequency range of a phone transmitter to 3 kHz at the upper end, thus limiting its bandwidth requirement to 6 kHz.

While courtesy and sharing are important, there are more selfish reasons also for limiting the frequency range of a phone signal. The phone company studies have shown that voice components outside the 3 kHz "communications" region are not worth the effort required to transmit them. By restricting the bandwidth, then, you can make all the sideband power into *effective* power and not waste any of it. This means a stronger signal at no extra cost, or, to put it another way, less cost per unit of signal strength! If courtesy doesn't convince you, maybe economy will.
that

If we're using FM rather than AM, then the relation between modulating signal and bandwidth is a bit different. We'll go into that in more detail when we look at how AM and FM carry voice. For right now, the key difference is that with AM, it's the frequency range or bandwidth of the audio which determines the bandwidth of the transmitted signal, while with FM, it's the amplitude or intensity of the audio which sets bandwidth of the transmitted signal.

Even with AM, though, the amplitude of the signal has some effect upon bandwidth. Specifically, if the audio signal is too strong for the carrier, it will tend to cut off all carrier power on negative-going peaks. This causes a "clipping" of the audio, which creates an extremely wide band signal. The "splatter" which results can interfere with all the signals in a single ham band, and is prohibited by FCC regulations. So long as signal amplitude is kept below this limit, however, only the frequency of the audio can affect bandwidth of an AM signal.

The important points to remember out of what we've covered so far, then, are these: Any modulation of a signal must increase its bandwidth, with the bandwidth increase being determined by the rate or speed at which information is conveyed. Slow-speed CW has the narrowest bandwidth, and TV video (which must carry the equivalent of millions of bits of information per second) the widest. For any one type of modulation, the bandwidth is primarily dependent upon a single characteristic of the modulating signal. And finally, signals with greater bandwidth than

that required to carry the desired information are to be avoided for many reasons.

Now that we've learned a little more about just what modulation amounts to and how it's closely interwoven with signal bandwidth, let's see just how voice signals are carried by AM and FM.

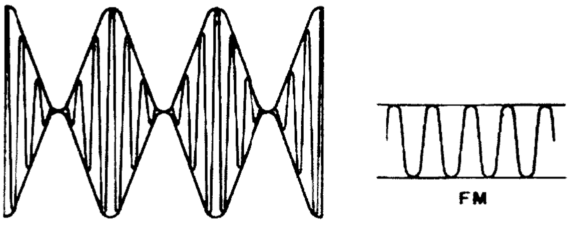

Fig. 1. Envelope waveforms of AM (left) and FM signals show that amplitude varies in AM, but remains steady with FM.

How Do AM and FM Carry Voice?

As we have already seen, the principal types of modulation used for ham phone transmission are AM and FM. The question now before us boils down to "How do they do it?"

The oversimplified view of how is far too condensed to be precise, but it is useful in getting a starting point: AM varies the strength of the signal (leaving the frequency constant), and FM varies the frequency (leaving the strength constant). This is often shown by "envelope waveforms" which are supposed to look something like those in Fig. 1, and "spectrum distribution" charts such as in Fig. 2.

As you can see, these show no significant frequency distribution for the AM signal, and no significant change in amplitude for the FM signal. And since you can actually see such displays on the face of a scope properly connected to the output of

Fig. 2. Spectrum distribution charts for AM and FM show that AM occupies fixed positions in the rf spectrum, while an FM signal appears to vary in frequency over a band of closely related frequencies. With most receivers, the AM spectrum distribution would appear to be a single point rather than the three points shown.

an FM or an AM transmitter, it's sometimes difficult to see just why these ideas should be "too simple."

The problem is that any scope hookup, and for that matter any receiver, cannot examine a single spot-frequency signal. Instead, it must act on a whole band of signals which make it through the "selectivity curve" of the device, and the result is influenced by all the signals in that band.

Thus when you have a 1000 kHz carrier wave, together with two side-frequency signals at 1000.5 and 999.5 kHz (each with the proper phase relationship to the carrier), neither the scope nor the receiver will actually show you these three signals as individuals. Instead, the overall *average* strength of the three will be shown – and that comes out as the typical "AM" envelope waveform. Figure 3 shows this by comparing two different spectral charts.

It's possible to prove this out by drawing each of the three signals separately, and

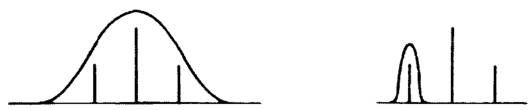

Fig. 3. AM appears to be a single-frequency signal to almost all receivers, and many spectrum analyzers, because the receiver's selectivity curve is so broad as to include the carrier and all sidebands as shown at left above. An extremely selective receiver (right), or analyzer, is capable of selecting any one component of the complete signal and isolating it.

adding up the instantaneous values for each at each point in time.

What really makes the whole thing a bit mystifying at first is that the conventional modulator circuits used to achieve AM really look as if all they do is control the amplitude of the signal. Take, for instance, the high-level plate-modulation circuit shown in Fig. 4.

Nothing would be easier than to look at this circuit as a means of controlling power output of the rf amplifier by adjusting its plate voltage with the audio signal to be transmitted. In fact, a couple of generations or so of hams learned solidly that this was just how it worked – the rf amplifier was said to act "like a resistor" and vary its output power according to the plate voltage, which was either lowered (if the audio

was going negative) or raised (when audio went positive). This is simple and clear-cut – and wrong. Those hams who learned it so solidly had a really rough time adapting to SSB when it came in, because SSB forces you to know how it really does work instead of a might-be explanation that isn't correct regardless of its glibness.

What really happens is this: The amplifier receives two separate signals, one at radio frequency (the normal input signal) and the other at audio frequency (though its power leads). Because of the variation in operating conditions, and more to the point, because the rf amplifier distorts its signals (and therefore is not a linear device), these two separate signals interact with each other and the result is not just one, or even two, but four signals at the output. These four output signals consist of the two input signals and two new signals. One of the new signals has a frequency equal to the sum of the frequencies of the two input signals, and the other has a frequency equal to the difference.

same process every time – any time that two signals meet in a nonlinear device (it doesn't even have to be an amplifier), we're going to get four signals out.

You may have noticed that these "new" signals which appear in the output of our modulated amplifier are identical with the side-frequency signals we met earlier.

The appearance of a change in signal strength is, as we mentioned, because at any one instant the net energy in a circuit depends on *all* the signals present, and the phase relation between carrier and sidebands is such that the sidebands alternately add to and subtract from the carrier-wave signal's power to give the appearance (and practical effect) of varying signal amplitude.

Once the basic idea of what really happens during modulation takes hold, it's much easier to see how such circuits as the grid-modulated amplifier (Fig. 5) can work. These are a bit difficult to comprehend on a straight amplitude-control basis, but when you look at modulation as being essentially a mixing process, things come

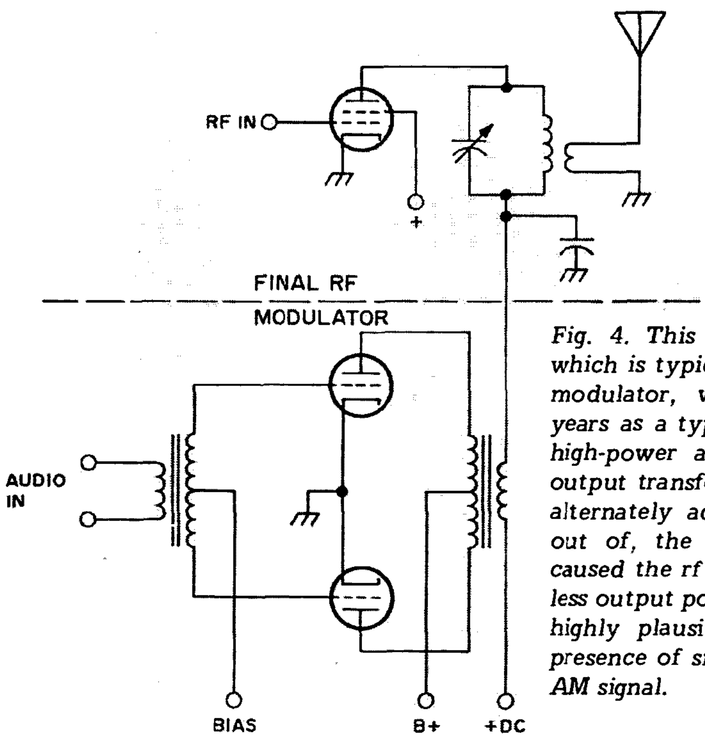

Fig. 4. This high-level plate-modulation circuit, which is typical of the most popular type of AM modulator, was wrongly explained for many years as a type of "valving" action in which the high-power audio signal from the modulator's output transformer or "modulation transformer" alternately added power to, or canceled power out of, the steady dc supply level, and thus caused the rf amplifier stage to produce more or less output power accordingly. The explanation is highly plausible, but fails to account for the presence of sidebands which are present in every AM signal.

When the two input signals are far apart in the rf spectrum, as they are in this case, we call this process amplitude modulation. If the input signals are closer together, we call it "mixing," and we'll meet it again several times as we progress through this course. No matter what we call it, it's the

through more clearly. The major difference between the different amplitude modulators then boils down to "where the audio is fed in."

The mixing-action principle also explains why bandwidth of an AM signal depends upon the bandwidth of the audio

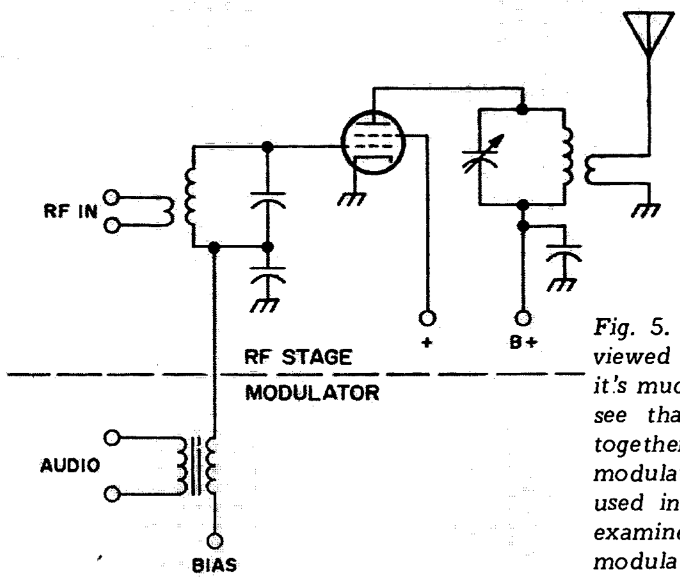

Fig. 5. Grid-modulator circuit for AM could be viewed as valving action by way of grid bias, but it's much easier to take the correct viewpoint and see that the rf and audio input signals mix together in the amplifier stage to produce a modulated signal as the output. Mixer circuits used in receivers and SSB exciters, which we'll examine next time, are very similar to this grid modulator circuit.

signal applied to the modulator. The higher the maximum frequency in the audio signal, the higher will be the sum or upper sideband limit, and the lower will be the lower sideband limit. Since signal bandwidth is the difference between upper and lower sideband limits, this means that high-frequency audio means wider bandwidth.

With single sideband signals, incidentally, both the carrier and one sideband are normally suppressed, and the bandwidth is thus cut to be roughly equal to that of the audio signal fed in (or half that of the corresponding AM or DSB signal).

The basic principle of FM is, unfortunately, not so easy to see accurately. The simplified principle (which is no more

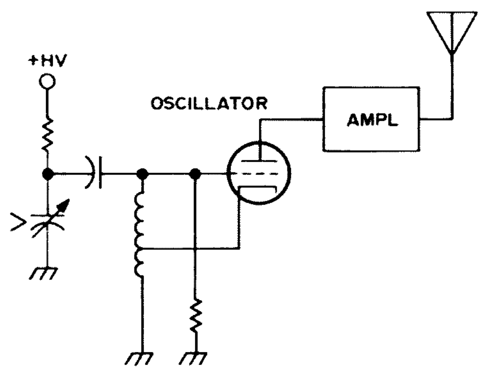

Fig. 6. Oversimplified view of how frequency modulator works is provided here, where capacitor microphone (in which capacitance is changed by sound waves striking it) serves as tuning capacitor for oscillator in the transmitter. Speech causes capacitance to vary, which changes transmitter's frequency. In practice, voltage-variable capacitor is used and voltage applied to it is varied by audio signal.

accurate than the amplitude-control idea of how AM works) is typified in Fig. 6, where a capacitor microphone is used to vary the frequency of an oscillator, directly controlling the frequency of the transmitted signal. This was the old standard explanation, but as we said it's not accurate. The fact is that FM signals have sidebands just like AM signals do, and what's more the only difference between (ham style) FM and AM in the sidebands is that FM's sidebands are phased differently with respect to the carrier. (Wideband broadcast FM has many more pairs of sidebands than does AM; that's where much of its improved audio quality comes from.)

The big difference in sideband phase is shown in Fig. 7. You can see that where both the AM sidebands are going up, one of the FM sidebands goes down. Thus the two FM sidebands appear to cancel each other so far as amplitude is concerned, giving rise to the steady envelope we saw in Fig. 1. However, this imbalance between the sidebands makes their effect on apparent carrier frequency much greater, so that the frequency of the composite signal appears to swing with FM, where it remains constant with AM. In fact, as the modulation level is increased, you can reach a point with FM where the effect of the two sidebands is to completely cancel the carrier wave. This is called the point of "vanishing carrier" and can be used to measure modulation level.

The fact that sideband phase makes the difference between AM and FM is the basis of the Armstrong system for frequency modulation, which made commercial FM

practical. This system used conventional AM techniques, but took the carrier out of the signal and shifted its phase by 90 degrees, then put it back. The result was FM.

A not-so-widely known fact, suggested by the sideband relationships shown in Fig. 7 and proved by experiments a number of years ago, is that you can combine AM and FM of the same signal to produce an AM output signal with only one sideband.

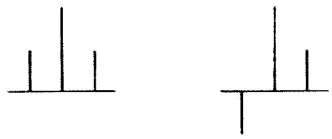

Fig. 7. Essential difference between AM sidebands (left) and FM sidebands (right) is in their phase with respect to carrier signal. AM sidebands are completely symmetrical about carrier; FM sidebands are offset in phase and so pull frequency to one side or other instead of affecting envelope amplitude. This is shown in these plots by reversed direction of lower FM sideband.

This is not SSB as we know it, because the carrier is not suppressed, but by proper adjustment of the levels of both types of modulation you can make the "upside-down" FM sideband cancel the corresponding AM sideband, while the carrier and the other sideband reinforce each other. The technique has been used on SWBC stations, but it's illegal for hams – because FCC regulations prohibit simultaneous FM and AM of the same signal.

Practical ham FM modulator circuits usually involve phase modulation of some type which is made to look like FM by adjustment of the audio frequency response (that's the only effective difference between FM and PM). The phase modulation is achieved by electronically detuning a tank circuit, to cause the tank's phase shift to vary in step with the audio signal.

Why and How is Modulation Measured?

To carry information of any sort, a radio signal must be modulated. Modulation consists of varying the characteristics of the signal in order to transmit the information. Naturally, when we vary any characteristic we can either vary it only slightly, or we can carry the variation to extremes – and so the degree of modulation applied to the signal can vary from almost none up to some limiting point.

The measurement of modulation is the determination of the degree of modulation applied to a signal, and it's necessary to measure modulation of any modulated signal for a number of reasons.

Most of these reasons boil down to the basic factor of complying with rules and regulations. For instance, we've already mentioned that it's illegal to apply both AM and FM to the same signal at the same time in the ham bands. To be sure that we are complying with this rule, we have to be able to measure both the AM and the FM of the signal, and be certain that whenever one is present, the other is not.

We've also seen that the bandwidth of the modulated signal is determined by its modulation. FCC rules limit the bandwidth of a ham signal, and so we must perform modulation measurements to be certain that we remain within the bandwidth limit.

When too much AM is applied to a signal, we saw that the result is "splatter," which interferes with other communications over a wide band of the spectrum. Because of this, the level of AM permitted is limited. Again, we must make measurements to assure ourselves that we are complying with the rules.

Before we can examine the how of modulation measurement, we must meet some of the words and phrases we'll be using. The quantity most often measured is known as "percentage of modulation," and is derived from the instantaneous rf voltages present in the modulated signal as shown in Fig. 8 when we're talking about AM. An unmodulated carrier has a modulation percentage of zero, while a fully modulated signal is 100% modulated. While it's possible to exceed 100% modulation, doing so is forbidden by FCC rules because of "splatter," and such a condition is called "overmodulation." Most good AM signals average about 80% modulation; some safety factor is necessary to keep from going over 100% with audio peaks. The average broadcast signal has only about 30% modulation.

Since the amplitude of an FM signal does not vary when it is modulated, "modulation percentage" as defined in Fig. 8 is meaningless if applied to FM; all signals would be 0% modulated. The corresponding term for FM is "modulation index," which is the ratio of signal frequency deviation to modulating signal frequency. For broadcast FM, the modulation index is

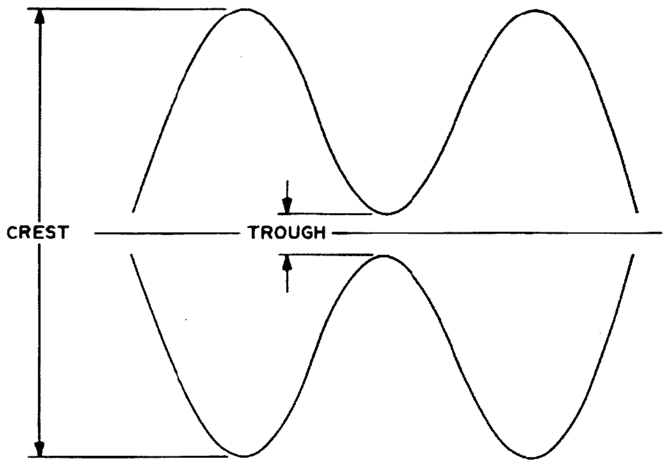

Fig. 8. For AM signal, modulation percentage is a function of "crests" and troughs on a "sum and difference" basis. The resulting fraction is multiplied by 100 to change it into a percentage. Both crest and trough quantities are usually measured as voltages. In this example, crest is 86 units and trough is 12 units, so modulation percentage is (86–12)/(86+12) or 74/98, which comes out to 0.755, or 75.5%. Modulation percentage as defined here is meaningful only for AM; since FM has no amplitude variation, it would always come out to 0%.

usually much larger than 1.0, but in ham FM the modulation index is usually 1.0 or less.

Now we're ready to look at the techniques of modulation measurement. We'll take up AM measurements first, since most ham work on the HF bands makes use of AM, and then turn our attention to FM.

For AM, the most useful measurement is that of modulation percentage. The oscilloscope is the best instrument for measuring modulation percentage, but simpler devices may also be used to assure compliance with FCC regulations.

With most types of AM, the plate current of the final rf amplifier remains constant with proper modulation, but overmodulation (more than 100%) will cause the plate-current meter's needle to flicker. This is the simplest go/no-go measurement of modulation, and will suffice to meet FCC requirements.

A high-resistance ac voltmeter may also be used to measure the ac voltage produced by the modulator; this can be calibrated in percentage of modulation (by comparison with scope measurements, one time) and is more accurate than the plate-current indication. The calibration will be correct only so long as the dc voltage to the modulated stage remains unchanged.

Neon tubes may be used as visual indicators of modulation percentage, by connecting them through diodes so that they compare the instantaneous supply voltage of the modulated stage to the unmodulated voltage and thus flash whenever a specified percentage of modulation is exceeded. Figure 9 shows such a circuit, set up with three bulbs which glow at 50%, 80%, and 100% modulation. Similar circuits may be set up with "magic-eye" tubes as indicators.

To measure modulation percentage with an oscilloscope, the modulated rf signal is applied directly to the vertical plates and the modulating audio signal is applied to the horizontal plates. In the absence of

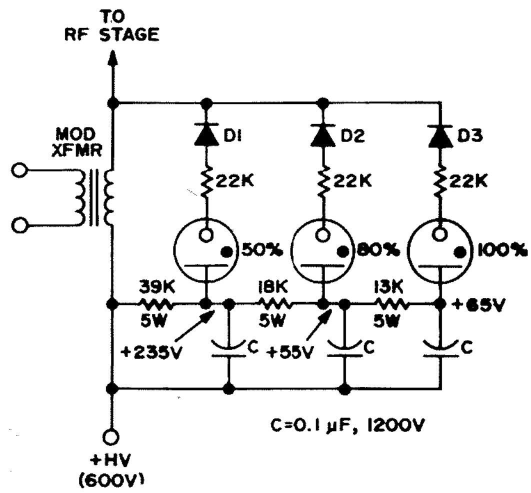

Fig. 9. Simple devices can be built to indicate when defined modulation percentages are achieved. This arrangement uses neon bulbs and switching diodes to fire the bulbs when the negative-peak modulation reaches 50%, 80%, and 100% respectively. Bottom ends of neon bulbs return to voltages which are uniformly 65V more negative than the voltage marking the corresponding modulation percentage. These voltages, and the resistance values in the divider which establishes them, depend upon the voltage supplied to the transmitter (here assumed to be 600V). The 65V offset is the firing voltage of the neon bulb. When the upper end goes 65V more negative than the lower end, the corresponding bulb can fire. In use, the object is to keep the 50% bulb on all the time, the 80% bulb on as much of the time as possible, but never permit the 100% bulb to flash.

modulation, the display is a single vertical line in the center of the screen, because no horizontal deflection voltage is available. This vertical line is a picture of the carrier, and its height is proportional to the carrier's intensity.

When modulation is applied, the modulating signal provides horizontal deflection to the scope and at the same time causes the carrier's intensity to vary. At the positive peak of the modulating signal, carrier intensity will be maximum, and the display will be at one limit of its horizontal deflection. At the negative peak of the modulating signal, carrier intensity will be minimum, and the display will be at its other horizontal limit.

With 100% modulation, in which the maximum carrier intensity is twice that of the unmodulated carrier and the minimum carrier intensity is zero, the resulting display is a triangle. With less than 100% modulation, it is a trapezoidal shape, and for this reason the scope measurement method is often called a "trapezoid pattern" modulation measurement. With more than 100% modulation, the triangle develops a horizontal line at its tip, representing the excess modulating signal (the carrier

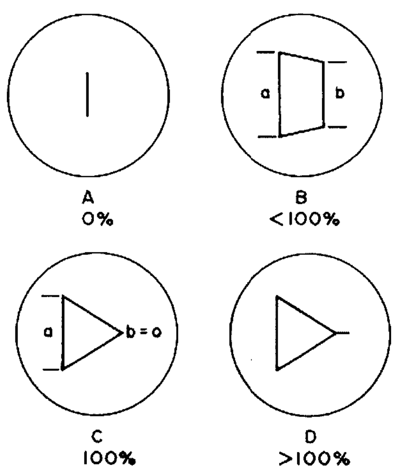

Fig. 10. Trapezoid patterns for 0%, less than 100%, 100%, and greater than 100% (overmodulated) modulation percentages are shown here in ideal form. Modulation percentage can be measured directly from scope screen by taking the fraction (a—b)/(a+b) and multiplying by 100 (patterns B and C). When b=0 as in C, this becomes a/a or 1 times 100, for 100% modulation. In addition to indicating modulation percentage, this measurement tells whether modulator is distorting the audio signal. Clean signal is indicated by straight sides. Any kinks or curvature of the slanting parts of the display mean trouble in the transmitter.

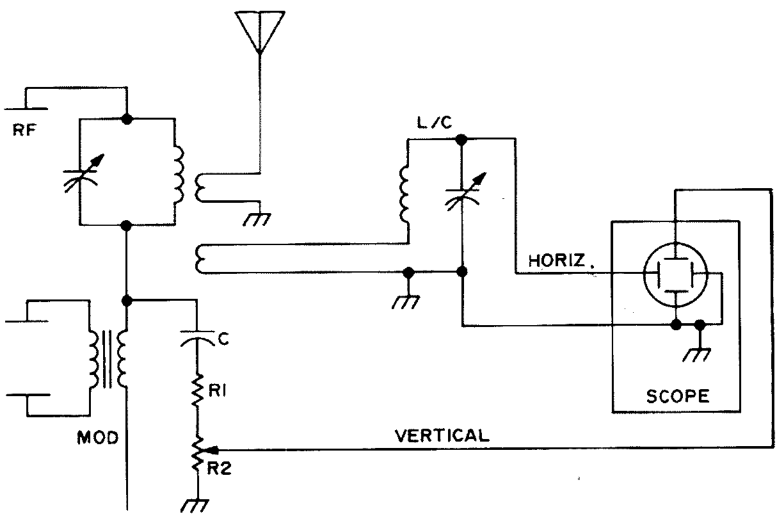

Fig. 11. This is how to hook up scope to get trapezoid patterns of Fig. 10. Rf is sampled from final tank circuit by means of link coil and tuned circuit L/C, and fed to vertical plates of scope through short, direct connections. Audio is sampled from secondary of modulation transformer and applied to horizontal plates. Capacitor C is safety blocking capacitor to prevent supply voltage from getting into scope; resistors R1 and R2 cut down audio signal level as required, and may not be necessary for low-power rigs. Size of display is adjusted by tuning of L/C and setting of R2.

cannot reach less than zero intensity). Figure 10 shows these patterns, and Fig. 11 shows the typical test hookup for the average ham transmitter.

The value of the scope method over all simpler techniques is that the two vertical edges of the display are direct representations of the quantities which define modulation percentage, and so you can calculate modulation percentage accurately from the scope display by the formula shown in Fig. 10. In addition, the slanting edges of the display are drawn by the two signals involved, and should be straight at all times. Any kinks indicate distortion being produced by the modulator, which could result in interference to other signals and even at best would mean a sloppy output signal.

Scope measurements can be made on any AM transmitter, since they simply compare the signal doing the modulating to the signal being modulated. The simpler techniques apply primarily to high-level plate-modulated transmitters (the most

common type), and must be used with caution if any other modulating technique (screen, grid, or cathode modulation, for instance) is employed.

When it's FM instead of AM you're measuring, the situation is somewhat different. Most of the common modulation measurement techniques apply only to AM, and cannot be used for FM.

The accurate technique for measuring FM involves a device known as a spectrum analyzer, which is not normally found in a ham shack. The normal ham technique is to locate the point at which the first pair of "extra sidebands is produced. This requires a 3 kHz oscillator and a sharp-tuning receiver capable of detecting one signal which is only 3 kHz away from another, stronger signal.

The transmitter is modulated with the output of the 3 kHz oscillator, and the output signal is examined with the receiver. Both the carrier and the side frequencies 3 kHz either side of it should be detected. Audio gain of the modulator is now slowly increased until a second pair of side frequencies, this time 6 kHz away from the carrier, appears. The gain should be backed off until the second sidebands just disappear, and this point marked as a modulation index of 1.0.

An ac voltmeter may be installed in the modulator to measure signal level for the 1.0 modulation index, and when a microphone is substituted for the oscillator the gain can be adjusted so that this modulation index is never exceeded.

At certain points, the carrier of an FM signal appears to vanish. This occurs as the modulation index is increased past 1.0. The first point of vanishing carrier is at a modulation index of 2.4; the next one is at a modulation index of 5.52, and the third at 8.65. Similarly, the first pair of sidebands vanishes at modulation indexes of 3.83, 7.02, 10.17, and 13.32. Modulation indexes greater than about 8.0 are too wide for even VHF FM bands, but the points of vanishing carrier and vanishing sidebands can be used to set certain indexes with certainty.

The technique is similar to detecting the second sideband pair; the difference is that the receiver is left tuned to the carrier, and the audio gain increased until the carrier vanishes. This represents a modulation index of 2.4. The receiver is then tuned to the first pair of sidebands, and gain in-

creased until they vanish. This is a modulation index of 3.83. Back to the carrier, and increase modulation until it vanishes again at 5.52, and so forth. If two separate audio gain controls are provided on the modulator, one can be used to set modulation level and it can be calibrated by this technique; the other can then adjust for differences between microphones.

VHF FM enthusiasts sometimes use "frequency deviation meters" to adjust or measure modulation level of their transmitters. These meters are similar to FM receivers, and provide direct indication of the bandwidth of the modulated signal.

...Staff

73 Reader Service Coupon

Now we don't say that every single reader must buy every last product advertised in 73. We believe that, but we don't say it. The very least every reader can do is to put on a show of interest in the products herein advertised. To make this a simple task, even for the laziest reader (now there is a contest for you!), we have cleverly arranged the advertising index to double as a readers service coupon. All you have to do is tear it out (or photocopy it) and send it in with the appropriate boxes marked. (We have a prize for the most boxes marked . . . a silent prayer of thanks from the publisher). We'll accept postcards, slips of paper, or almost anything else that lists the companies you want to hear from and your address.

No one likes to go into a store without buying something, right? It is the same with these information requests. You will be expected to buy something. Oh, it doesn't have to be a $50,000 antenna system, but it should be something modest . . . a transceiver . . . a linear . . . you know. We'll leave the decision up to you, knowing that we can trust you to do the right thing.

And we are definitely not saying that the use of this service coupon has any curative powers, but we cannot but notice that many readers report remarkable relief from simple backache, headaches, lumbago, and acid indigestion after sending in their coupon. Why take any chances?

ADVERTISER INDEX

Mail to: **73 INC., PETERBOROUGH NH 03458**

Name ______________________________

Call ______________________

Address ______________________________

______________________ Zip ______________

PROPAGATION CHART
J. H. Nelson
Good (open) Fair O Poor□

June 1971

SUN	MON	TUES	WED	THUR	FRI	SAT
		1	2	3	4	5
6	$\boxed{7}$	8	9	10	11	12
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20	21	22	23	24	25	26
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EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	14	14	14
ARGENTINA	14A	14	14	14	14	7	14	14	14A	21	21	21
AUSTRALIA	14	14	14	7A	7B	7	7	7	7	7B	14	14
CANAL ZONE	21	14	14	14	7A	7	14	14	14	21	21	21
ENGLAND	14	14	7A	7A	7	7	14	14	14A	14A	14A	14
HAWAII	14	14	14	7A	7	7	7	14	14	14	14	14
INDIA	14	14	7A	7B	7B	7B	7A	7A	14	14	14	14
JAPAN	14	14	7A	7A	7B	7B	7B	14	14	14B	14	14
MEXICO	14	14	14	14	7	7	7	14	14	14	14	14
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SOUTH AFRICA	7B	7B	7	14B	14B	14	14	14	21	14	14	14B
U. S. S. R.	14	14	7A	7A	7	7A	14	14	14	14	14	14
WEST COAST	14	14	14	7A	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7	7	7A	14	14
ARGENTINA	14	14	14	14	14	7	14	14	14	21	21	21
AUSTRALIA	14	14	14	14	14	7	7	7	7	7B	14	14
CANAL ZONE	21	21	14	14	7	7	14	14	14	21	21	21
ENGLAND	14	14	7A	7A	7	7	7	14	14	14	14	14
HAWAII	14	14	14	14	14	7	7	14	14	14	14	14
INDIA	14	14	14	7B	7B	7B	7B	7A	14	14	14	14
JAPAN	14	14	14	7A	7B	7B	7B	14	14	14	14	14
MEXICO	14	14	14	7	7	7	7	7A	7A	14	14	14
PHILIPPINES	14	14	14	7A	7B	7B	7B	7A	7A	14	14	14
PUERTO RICO	14	14	14	14	7	7	7A	14	14	14	14	14
SOUTH AFRICA	7B	7B	7	7B	7B	14B	14	14	14	14	14	14B
U. S. S. R.	7A	7A	7A	7A	7	7	7	7A	14	14	14	14

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	7	7	14	14	14
ARGENTINA	14	14	14	14	14	7	14	14	14	21	21	21
AUSTRALIA	21	21	21	14A	14	14	7	7	7	7	14	21
CANAL ZONE	14A	21	14	14	7A	7A	7A	14	14	14	14	14
ENGLAND	14	7A	7A	7A	7	7	7	14	14	14	14	14
HAWAII	21	21	21	14	14	14	14	14	14	14	14	14A
INDIA	14	14	14	14	7B	7B	7B	14	14	14	14	14
JAPAN	14	14	14	14	14	7A	7	7A	14	14	14	14
MEXICO	14	14	14	14	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	14	7A	7B	7A	7A	14	14	14
PUERTO RICO	14	14	14	14	7A	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7B	7	7B	7B	7B	14B	14	14	14	14	14B
U. S. S. R.	14	14	7A	7A	7	7	7	7A	14	14	14	14
EAST COAST	14	14	14	7A	7	7	7	14	14	14	14	14

A = Next higher frequency may be useful also.
B = Difficult circuit this period.


AMATEUR RADIO
73
VHF SUMMER SPECIAL
#130
July 1971
One Dollar
K5JRR
OCT. LOUISIANA 58
CALIFORNIA 56
W6 RV
KANSAS 62
WØROF
10.000 LAKES
KØKKO
19 . MINNESOTA . 60
NORWX
QUÉBEC
VE2 BE
EXP NEVADA JUN 55
W7CNG
19 SUNSHINE STATE 61
W4RWM
FLORIDA
1959
VE6BY
ALBERTA
TENN 62
W6THN
19 MICHIGAN
W8PT
WATER WONDERLAND
VE-1 AFZ
NOVA SCOTIA '60
W7ABO
WYO 60
K9GNE
AMERICA'S DAIRYLAND
19 LIVE FREE OR DIE 70
W2NSD
NEW HAMPSHIRE
W7 IDF
WASHINGTON
W4API
19 VIRGINIA
W5TL
19 LOUISIANA 60
KANSAS 61
WØZGH
CALIFORNIA
W6 UBU
K8KTM
OHIO
19 ILLINOIS 61
K9EBA
LAND OF LINCOLN
NEWFOUNDLAND 62
VO-1 BL
K9PJZ
W8SVU
1961 - OHIO
ARKANSAS 62
W5WEE
10.000 LAKES
WØJHS
19 . MINNESOTA . 60
19 MICHIGAN
K8LUY
WATER WONDERLAND
CALIFORNIA 56
K6 ICS
ALASKA
KL7DQD
FLORIDA
W4GJO
19 SUNSHINE STATE 58
W6SEU
19 CALIFORNIA
MISSOURI
W40iJ
19 ILLINOIS 61
K9QNV
LAND OF LINCOLN
OREGON 55
W7LWM
CALIFORNIA
WA6ZG

73 MAGAZINE

#130 JULY 1971

STAFF

FEATURES

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73 Magazine is published monthly by 73 Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas, $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough, N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. *Phone: 603-924-3873. It is henceforth forbidden to permit any friend or relative to read your subscription copy of 73 Magazine. Let them buy their own copies.*

Cover: From the dusty reaches of the W2NSD/1 garage comes this collection of ham license plates. We invite all 73 readers to send us their old call plates so we can replace all the shingles on the 73 barn with call plates.

Amateur Radio News Page

JULY MCMLXXI | Monthly Ham News of the World | 73 MAGAZINE

"EYEBANK" INQUIRY PLANNED

The "Eyebank" controversy has had its impact on the FCC, with the result that the Commission will conduct an inquiry into applicable "Rules."

The Commission's Rules governing the amateur radio service prohibit issuance of an amateur station license to a "school, company, corporation, association or other organization, nor for its use . . . " (Section 97.39). The only exception is for "a bonafide amateur organization or society." Another Section, 97.107, permits an exception during declared emergencies when normal communications are disrupted.

Over the years, however, amateur stations have been used for nonemergency communications in behalf of certain nonamateur organizations such as the Red Cross, Eyebank Association, and the March of Dimes. There has been general agreement that these operations are meritorious.

Recent developments have required a closer look at the requirements of the rules in relation to operation in the interest of other than amateur organizations. "There is evidence of a considerable proliferation of nonamateur organizations with an interest in the use of amateur frequencies and amateur stations for purposes which may well lack the universal acceptability of Red Cross and Eyebank objectives.

international communications transmitted by amateur stations "to messages of a technical nature relating to tests and to remarks of a personal character for which by reason of their unimportance, recourse to the public telecommunications service is not justified." While there is no similar provision applicable to domestic operations, Section 3(q) of the Communications Act in effect defines an amateur operation "as a person interested in radio technique solely with a personal aim." Extensive use of amateur radio for any third party would not appear to be compatible with that definition.

As previously noted, there is general recognition of the public benefit derived from limited use of amateur stations on behalf of such organizations as the Red Cross, Eyebank, and the National Cystic Fibrosis Foundation. Such recognition may not, however, be nearly as universal when considering the possible use of amateur radio on behalf of other nonprofit, public service organizations such as political parties, student organizations, various churches and missionary societies and a large number of other and more controversial groups.

In order to assist the Commission in making determinations in these important and controversial areas, all

National Releases New Receiver

National Radio Company, Inc. of Melrose, Mass. recently announced the attainment of a major milestone in the company's revitalization program. The HRO-600 VLF-HF Full-coverage Receiving System was successfully tested and qualified against an up-graded specification invoked by the United Kingdom Ministry of Post and Telecommunications. NRCI's HRO-600, frequency range in AM, CW, SSB, FSK, FAX modes, and will accept any one of several frequency control plug-in units (VFO, Synthesizer, Fixed Channel Crystal Control). Both the VFO and Synthesized versions were tested and qualified. The design configurations provide for a wide variety of multimode and multipurpose applications. Additional markets for the

WALKER NAMED FCC CHIEF

A. Prose Walker, an engineering consultant and former FCC staff member, has been named chief of the Amateur and Citizens Division succeeding Everett G. Henry, who retired earlier this year. Mr. Walker had headed his own consulting firm after serving as a consultant with a Washington, D.C. engineering group. He was employed by Collins Radio from 1961 to 1968 in various positions, including most recently, manager of broadcast and general communications in Washington, D.C. From 1953 to 1961 he was manager of engineering for the National Association of Broadcasters and in 1960 was the editor-in-chief of the NAB Engineering Handbook. Mr. Walker joined the FCC in 1940. During World War II he worked in the area of radio intelligence and direction-finding, moving to the Broadcast Bureau in 1946. As chief of the TV allocations branch, he participated in the 1947 Atlantic City World Administrative Radio Conference and attended the high frequency broadcast conferences as a member of U.S. delegations.

tives," the FCC said. Unlimited operation in behalf of such organizations could generate large numbers of new networks and the use of amamateur radio as a medium for the organized advocacy of social, political or economic views could preempt amateur frequencies to the exclusion of the individual amateur for whom the service was intended.

The current rule is clear and unambiguous. It permits no such operation other than as previously noted. Therefore, while the Commission essentially agrees with those amateurs who believe that limited communications in behalf of the Red Cross, Eyebank, March of Dimes, National Cystic Fibrosis Foundation, and similarly oriented organizations are meritorious, it concludes that they are not permissible under Sections 97.39 and 97.107 as they now read and, if the communications are to be permitted, the rules must be amended.

If this is done, the question is raised as to whether some restrictions on the kind of organizations to be included and limitations on the type of communications so permitted will be required. The lines of demarcation between organizations to be made eligible and the types of communications to be permitted are by no means clear. It is one of the purposes of this Notice of Inquiry to elicit information and comment on the extent, if any, to which restrictions and limitations should be imposed.

Another factor to be considered is that Section 2 of Article 41 of the International Radio Regulations limits interested parties are requested to submit comments and suggestions relevant to the following issues:

I. Are any restrictions on the use of amateur stations in behalf of nonamateur organizations warranted?

II. If amateur radio stations should be permitted to furnish a communication service to nonamateur organizations;

(A) To what types of organizations?

(B) What types of activity or communication should be permitted?

(C) If there is to be a distinction between emergency and nonemergency communications, should emergency communications be limited only to those situations where normal communications are disrupted?

In accordance with provisions of Section 1.419 of the Rules, an original and 14 copies of all comments, suggestions, pleadings, briefs, or other documents shall be furnished the Commission. Tell the boys in Washington what you think.

HW-100 OWNERS

Jim Isham W8TXX of the Heath Company recently stated in the Philmont Mobile Radio Club *Blurb* if the HW-100 owners wanted to increase their receiver sensitivity they can change V-10 and V-11 to 6HS6's and they will see a marked change in receiver sensitivity. No other changes are necessary, just the tubes.

REGENCY ANNOUNCES AQUISITION

Instrument Flight Research, Wichita, Kanses, has been acquired by Regency Electronics of Indianapolis, Indiana. Floyd O. Ritter, Regency president, said the purchase was consummated by exchange of Regency stock for all assets and business of the IFR company.

IFR manufactures aviation electronics test equipment. Regency Aviation Division marketing officials, who will assume IFR sales responsibility, state that combining the two companies should result in great sales efficiency for both firms.

the latest in a 40-year genetic line of high frequency radio receivers, is the first U.S.-designed and manufactured equipment to pass this specification. The specification is intended for use by the world-wide maritime services for a ship's main and/or single sideband receiver.

The HRO-600 is capable of operating over the 10 kHz to 30 MHz receiver are: maritime shore stations, air-ground facilities, overseas communications networks, VLF-HF monitor installations, radio frequency control activities, and instrumentation programs.

Quantity production of the HRO-600 is currently underway, and it is anticipated that the receiver will be available for delivery in August, 1971.

Price Reduction: SMALL-SIGNAL PLASTIC TRANSISTORS

Phoenix . . . Motorola has just announced lowered prices for eight popular small-signal plastic transistors. Old and new prices are as follows:

The eight transistor types are backed by more than 25,000,000 device-hours of reliability testing, and exhibit failure rates which are among

Type	Quantity/Price		
	1-99	100-999	1000-499
1N3903	$0.55 ($0.75)	$0.39 ($0.50)	$0.29 ($0.37)
2N3904	0.55 (0.82	0.39 (0.55)	0.29 (0.41)
2N3905	0.55 (0.75)	0.39 (0.50)	0.30 (0.37)
2N3906	0.55 (0.82)	0.39 (0.55)	0.30 (0.41)
2N4123	0.39 (0.52)	0.27 (0.35)	0.16 (0.26)
2N4124	0.40 (0.60)	0.28 (0.40)	0.17 (0.30)
2N4125	0.40 (0.52)	0.28 (0.35)	0.17 (0.26)
2N4126	0.41 (0.60)	0.29 (0.40)	0.18 (0.30)

(Note: Figures in parentheses are the former prices.)

These devices include low noise, general purpose, switching, and amplifying transistors, useful to 300 MHz. All are rated at 310 mW power dissipation.

Types 2N3903 and 2N3904 are NPN high speed low-noise devices, while types 2N3905 and 2N3906 are their PNP complements.

The 2N4123 and 2N4124 devides are general purpose NPN transistors, with types 2N4125 and 2N4126 being the PNP complements.

the very lowest in the industry.

For more information, contact the Technical Information Center, Motorola Semiconductor Products Di' Box 20924, Phoenix AZ 85036

Moving? Please Let Us Know!

ARRL OFFERS TVI INFORMATION

The ARRL has published a sheet on TV set manufacturers who will supply a high pass filter for the suppression of interference. The list of twelve manufacturers is available free for a SASE sent to the League's headquarters, 225 Main St., Newington CT 06111.

REPEATER DIRECTORY UPDATE

We try to keep our open repeater directory current and up-to-date. However, new repeaters are coming on the air every day and others are changing frequency and adding channels. As a result of all this activity many errors and omissions have crept into our directory.

Below are the changes and corrections since the publication of our last comprehensive directory in the April 1971 issue of 73. We invite our readers to write in with any corrections and new information on repeaters anywhere in the world. With continued help from our friends we can maintain the most complete repeater directory available.

34/94 means the standard channel of 146.34 MHz input and 146.94 MHz output. All other frequencies are listed in megahertz with the input channel frequency first.

There is a new repeater in Rodsville MD on 52.80/52.68. The call is WA3BMM.

The K3PQZ repeater in York PA is no longer on the air on 34/76.

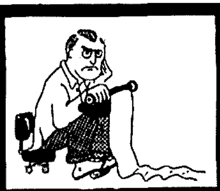
K8SXO in Ridgeley WV is reported to have moved and is off 34/76, 146.76/52.525, and 52.525/146.76.

There is a new repeater in Dunkirk NY: W2SB is on 34/94 and 146.25/146.85.

There is a new repeater on 146.37/146.97 in Manassas VA with the call WB4URR.

VE7CAP, Kimberley, B.C. has changed from 146.46/147.33 to 34/94.

Again – please keep 73 informed of any other changes or errors.



NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

An Old Editor?

Ken Sessions, who leaves us with this issue, has been one of the best editors 73 has ever had. Ken was responsible for the new and flashy layouts of the articles, the heavy emphasis on FM, and the virtual elimination of speling errers. Under his guidance 73 has continued to grow during a time of depression in the electronic fields which has severely hurt some of the other ham magazines.

All of us at 73 will miss the warm personal friendship and enthusiasm he brought to the job. Ken has promised to continue to write articles and keep the FM information coming in, so he will certainly not be dropping out completely. We all wish him well at his new and bigger job.

All of which means that you are stuck with me as editor again. On the plus side I should point out that whatever I lack in maturity and common sense I make up for in impulsiveness.

Good luck, Ken . . . good luck, 73 readers.

FM in 73

Has there been too much FM coverage in 73? A few readers have complained about this. Even more readers are in favor of the FM coverage. Perhaps some perspective is in order – call it justification, if you like.

Amateur radio has been kind of dragging along with little new to fire the imagination since the change to sideband some ten years ago. The changes in the General class band you can get a fine little FM rig and you are on the air through the local repeaters. You can use it in the car, at home, at work, or even in a boat. More and more hand units are coming out, too. While not too many of us can plunk down a long one for a sideband station, two short ones aren't all that hard to come by.

While I may be patting 73 on the back more than it deserves, I do note that a little over a year ago there were only a couple of FM rigs available and today there are over a dozen and the big problem is back orders. Distributors are raising cain trying to keep units in stock. This is fine for the amateur equipment industry (and they needed something like this pretty desperately), but the main benefactor is amateur radio itself . . . with thousands of stations coming on FM and having a ball.

While we won't be hitting FM quite as hard in the future, more due to Ken moving on to a much bigger job than any change in our thinking, we will be running all the good technical and construction material we can get our hands on plus keeping little items such as the repeater directory up to date, testing new FM gear and the like. Keep those articles acoming in . . . and those repeater changes and additions.

Errors in 73?

Some naive readers have the ridiculous idea that the gammatical, spelling and typesetting mistakes in 73 are accidental. No such thing. This is merely one aspect of our attempt to maintain our image as an amateur magazine. Perfection would be too

WWV-WWVH CHANGES BROADCAST FORMAT

Reported by W2AXU

When you tune in WWV for time signals or propagation information after 0000 hours Greenwich Mean Time (GMT) July 1, 1971, you will hear a different program format than you have been accustomed to over the years. The Morse code transmissions will be gone and the announcements of time and other information will be made in voice. The time will be announced every minute instead of every five minutes. A male voice will be used by WWV and a female voice by WWVH to distinguish between them. The carrier frequencies will remain the same – 2.5 MHz, 5.0 MHz, 10.0 MHz, 15.0 MHz, 20.0 MHz and 25.0 MHz. The frequency accuracy of the two stations is controlled by the NBS Atomic Frequency Standard at Boulder, Colorado. WWV is in Colorado and WWVH is located in Hawaii.

The format of the broadcasts from the two stations will be similar but to avoid confusion between the two stations, they will use alternate time slots for the transmission of tones, announcements, etc. The standard time tick each second will remain.

Each hour will be divided into one minute slots. Each minute (except the first) will begin with an 0.8 second 1000 Hz tone at WWV and 1200 Hz at WWVH. The first minute of each hour will begin with a 1500 Hz tone at both stations. The one minute slots will be divided into a 45 second segment and two 7.5 second segments. On alternate minutes the 45 second segment will contain either a standard tone (possibly 600 Hz) or an announcement.

It is interesting to note that the announcement slots will be available

the FM scene

by K6MVH

Repeater Problems

It certainly is easy for me to sympathize with people who write in telling me of their repeater problems. Perhaps a better word would be "empathize." I've installed a number of repeaters over the past few years and I've never unleashed one yet without controversy, complaint, and hard feelings on the part of at least a vociferous handful.

Here in New England there are dozens of repeaters operating successfully; but the road to success was rocky indeed for virtually all of them. The W1ALE repeater, for example, went up some time ago near Concord, N.H. Its duty cycle was the source of controversy, because it was on the popular .34/.94 set for 12 minutes, then it reverted to .46/.94 and 52.525/.94 for 3 minutes. If the latter operational sets were active, the repeater stayed in that mode, leaving the .34/.94 users with no repeater.

Then one day along came another amateur and another repeater. This repeater, assigned to K1ZJH, was to operate .34/.94 continuously. The only trouble was the fact that the repeater's range overlapped with W1ALE, so a few people – those most affected by the overlap – complained. The K1ZJH machine was running too much power on the output, and mobiles with low power couldn't key the repeater even when they could copy the machine full quieting. The output, they said, was causing interference in some places with W1ALE. But John Bertini, the repeater owner, was convinced that the low-power mobiles should increase their power if they in addition to all of Rhode Island, most of Connecticut and Vermont, all of New Hampahire, all of Massachusetts, and the greater part of Maine.

Needless to say, the repeater drew its share of fire from the members of the other repeater groups. Amateurs who were not members of the other groups, of course, were delighted with the repeater and the coverage it offered. But stations in Boston found that they could key the 73 Magazine repeater (WA1KGO) as well as their own local machine with each transmission. And to their dismay, the output of the WA1KGO repeater was as potent in Boston as the Boston repeater itself. Users of W1ALE and K1ZJH had similar reports. They found it difficult to communicate on their own private repeater when the WA1KGO repeater was being used.

Wayne and I decided to move the repeater to another set of frequencies (146.37/146.73) to avoid further interference to the other repeaters, but we met with a number of objections from the amateurs who liked the extended .34/.94 coverage.

Should we change the repeater output? Should we leave the repeater on .34/.94? We at 73 are faced with a dilemma of concepts: On the one hand, there are people who believe that .34/.94 should give saturated coverage over as much area as possible – the whole U.S., if such were feasible. On the other hand, there are others who feel that .34/.94 should be used for limited coverage over small areas only. Those who take this latter view feel that transients get the advantage of a repeater no matter where

segments, the dropping sunspot numbers, and other factors have worked to lessen enthusiasm . . . and fun.

Something new was in order. Something fun. Two-meter FM looked to me as if it would fill the bill. Repeaters had added that certain something which changed 2 meters from a frustration to great fun. As soon as I had my first personal experience through a repeater I knew that this was the way to go and, through great luck, was able to get Ken Sessions to guide 73 on the path to FM. Sure, we've gone a bit overboard, but wasn't it worth it? Thousands of 73 readers have succumbed to the siren call and are having the time of their lives.

Look at it this way. A low-band station generally runs about $1000 by the time you have the transceiver, tower, and antenna. For about $200

professional and put us in a class with, ugh, QST. In order to avoid this we intentionally include fourteen errors in each and every issue, thus preserving our image as blundering amateurs, not only at the radio hobby, but at publishing. We are preparing certificates of merit for readers who manage to spot all fourteen errors three months running.

Why Sideways?

The news pages are printed sideways and in small type for one basic reason: the material is of far less long-term value than the articles and thus doesn't really justify taking as much space as the articles do.

The side pages permit us to get almost 25% more material on a page. The smaller type increases this even more with the result that we are able to cram about two and a half pages of material onto each news page. If we were to print the news the same size as the articles, six double pages of news, letters and caveat emptor would fill over 30 pages of the magazine. Now be honest . . . wouldn't you rather have a little eyestrain on the news and have that many more articles? Your eyes certainly aren't any worse than mine, and I can read the news if I put on my glasses.

. . .W2NSD/1■

to Government agencies to use for their own purposes. The slots not used will be filled by another standard tone, probably 500 Hz. To prevent interference between the two stations where they can be received simultaneously, one station's announcements will coincide with the other's tone.

The first 7.5 second segment following the 45 second segment will be used by WWVH to announce time while WWV will be silent. The second 7.5 second segment will be used by WWV to announce time, WWVH being silent.

Each station will omit for 5 minutes of each hour all tones and announcements during the 45 second segments. This period will begin for WWV at 45 minutes past the hour and for WWVH at 15 minutes past the hour.

A special 440 Hz tone will be broadcast by WWV for 45 seconds beginning one minute past the hour and by WWVH two minutes past the hour. This tone can be used to mark the hours on strip-chart recorders or other instruments. The tone will be omitted during the zero hour of each UT day.

In summary, the standard time and frequency stations WWV and WWVH will revise their transmission program format on July 1, 1971 at 0000 hours GMT. Time announcements will be made in voice every minute – a male voice from WWV and a female voice from WWVH.

Courtesy of W2AXU and the Mt. Airy VHF Radio Club newsletter *Cheese Bits.*

wanted to use his repeater, and he held his ground. Eventually, the inhabitants of both repeaters grew accustomed to having them both on the air, and the controversy abated.

Then along came WA1NJR, a repeater in Boston. This repeater was installed because neither ALE nor ZJH offered any kind of coverage from the big city. But the people who were using the K1ZJH repeater moaned and groaned because the NJR machine was cramping their style near the fringe areas between the two repeaters. Clearly, the shoe was on the other foot.

To placate the people using the other repeaters, I'm told, the officers of the WA1NJR repeater lowered their power, thereby reducing coverage to the immediate vicinity of Boston. It didn't stop the gripes, but it reduced them to an insignificant whisper. And three repeaters were operational on the .34/.94 pair, all of which had a restricted area of coverage, and all of which overlapped with the others in some places.

Here in New Hampshire, we were repeater shy. Inhabitants of the Peterborough area (and indeed virtually all of Southern New Hampshire) could key any one of the three .34/.94 machines if they were equipped with fairly high-power base stations and efficient beams. But mobile operation was out of the question. So I installed a .34/.94 repeater on a mountaintop near Peterborough.

As it happens, the repeater I put up has no measurable desensitization; this fact, coupled with the elevation at which the system is mounted, accorded a degree of coverage that surprised everyone, including me. With a 10W output signal on the repeater transmitter, reliable two-way communication range can be maintained between 10W mobiles as far south as the New York border to as far north as the central portions of Maine. In essence, the repeater range includes all the areas covered by the three previously mentioned repeaters,

they go because of the proclivity of repeaters operating on that pair of channels. Proponents of the former idea feel that .34/.94 should be a universal, superrange set of frequencies, and that local repeaters should be on off-channels.

So I ask for the opinions of the amateur FM world at large. What do you think? Do you feel that supermachines should dominate .34/.94? Do you think local-coverage repeaters should dominate .34/.94? What we do with the WA1KGO repeater will depend on the opinions and reasoning of the FM readers who write in. Tell me what you think.

. . .K6MVH■

ANN LANDERS IN 73??????

DEAR ANN LANDERS: A few years ago my husband used to play a lot of cards. Harry was gone five nights a week. The only time I saw him was when he'd have the card game at our house. I got fed up making sandwiches, emptying ashtrays and cutting my way through cigar smoke. One day a friend told me how she cured her husband of the same thing. She got him interested in a ham radio.

This is not a cheap hobby, but I decided it was worth it. I bought Harry a set as a surprise birthday gift. Within weeks he gave up the cards to stay home and ham it up. Now he has started a short-wave romance with some woman who lives in San Antonio, Tex. She has a voice like Lady Bird Johnson. Their three-hour conversations are making me sick. Harry rushes home from work, bolts his dinner and makes a beeline for the radio.

Last week he couldn't contact the lady for three days and he was a wreck. When he finally reached her she explained she'd been out of town. He scolded her for not letting him know she was leaving . . . said he was "worried sick." The whole thing was so cozy I felt like belting him one. Furthermore, this ham thing is interfering with our sex life because Harry stays up until 2 a.m. most nights. (I think she does it on purpose.)

Now I wish he were back playing cards. What should I do? – DUMMY

DEAR DUMMY: Keep quiet. These two will probably talk themselves out. A woman who can't lure her man away from a piece of machinery has no imagination, Toots.

(Reprinted by permission of Publishers-Hall Syndicate and Ann Landers.)

REWARD

From Mars Newsletter England and *Cheese Bits*

A reward is offered for information leading to the capture of Eddy Current, charged with the induction of an 18 year old coil called Milli Amp, found half choked and robbed of valuable jeules. The unrectified criminal, armed with a carbon rod escaped from a primary cell where he had been kept in ions. The escape was planned in 3 phases. First he refused the electrolytes, then he climbed through a grid, despite the impedance of wardens and finally went to earth in a magnetic field. He has been missing since Faraday. It is thought that he escaped on a megacycle. Amen.

WINDSOR AWARDS

International Freedom
Festival Award

All contacts must be made in the period from June 24 to July 20, 1971. Only contacts with Windsor club-members shall be counted.

Two-way communications with an exchange of reports must be established.

Continental USA & Canada require 5 contacts; DX stations require 3 contacts; Essex county, Ontario, requires 10 contacts.

Send certified copy of log to Windsor Amateur Radio Club, Box 1322, Windsor 14, Ontario, Canada.

Rose City Award

All contacts (after Sept. 1) must be made with members of the WARC.

Two-way communications with exchange of reports must be established.

Essex county amateurs require 15 contacts and all other stations are required to work a minimum of 5 stations.

Send certified copy of log to Windsor Amateur Radio Club.

There is no charge for either award.

WORK THE CAPITOL

There is a nice certificate for working W3USS located in the U.S. Senate. They are often active Mondays through Fridays from 1800 to about 1900 GMT. The best place to look for them is between 21350 and 21360 kHz. For the certificate, send 2 IRCs and a large envelope to W3USS, Capitol Hill ARC, Box 73, Senate Office Bldg., Washington DC 20510.

Christian Amateur Radio Fellowship

The Christian Amateur Radio Fellowship will hold a workshop at the North American Christian Convention to be held in Dallas TX July 8, 1971.

'71 DELTA QSO PARTY

All amateurs are invited to participate in the second annual Delta QSO Party which is sponsored by the Delta Division of the American Radio Relay League.

Contacts must take place from 2000 GMT Aug 28 to 0200 Aug 30. No time or power restrictions.

Amateurs outside the Delta Division will attempt to contact as many amateurs inside the Delta Division (ARK, LA, MISS, TENN) as possible. Delta Division amateurs will attempt to contact as many amateurs as possible both inside and outside of the Delta Division.

The exchange will consist of QSO Number, RST, and QTH (ARRL section for non-Delta Division, county and state for Delta Division). Logs must include date/time, station worked, exchange, band, emission, and multiplier. Stations may be worked on each band/mode. Mobiles may be re-worked if they change counties.

For more info, write: Malcolm P. Keown W5RUB, 213 Moonmist, Vicksburg, Miss. 39180.

PENNSYLVANIA

The 34th annual hamfest of the South Hills Brass Pounders and Modulators will be held on August 1 from noon til dusk at St. Clair Beach, McMurray PA, 5 miles south of Mt. Lebanon on Rt. 19. Swap and shop, picnic space for the family, mobile check-in on 29.0 and 50.4. Information and preregistration at $1.50 per ticket ($2 at door) from Lou Cowan, 26 Graper St., Pittsburgh PA 15227).

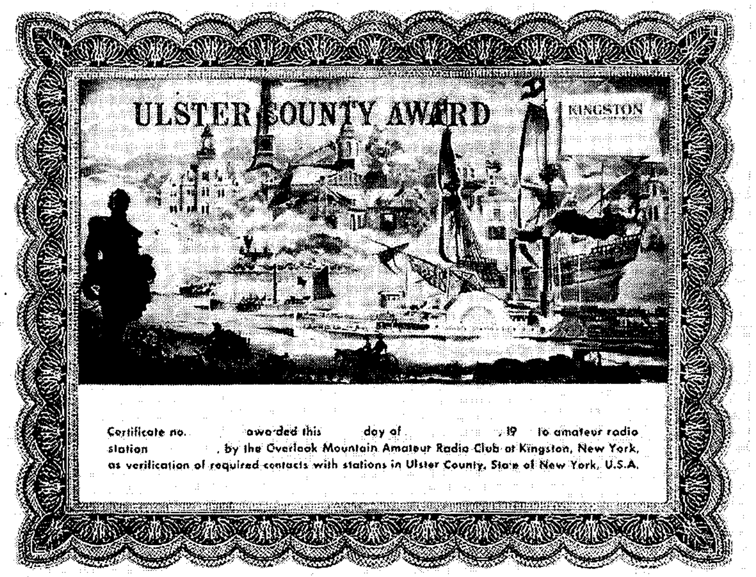
The Two Rivers Amateur Radio Club of McKeesport will conduct its seventh annual hamfest on Sunday, July 18. This event will be held at the Balkan grounds, Coulter Road, McKeesport, Pennsylvania. Our past ham-

WAS-AT AWARD

The Dayton Amateur Radio Association will sponsor a "worked all states-by amateur television" award to encourage and promote the latest mode of communication by amateur slow-scan television. A handsomely engraved plaque will be presented to the *first amateur* who completes 50 state two-way contacts by SSTV. At this time there may not be SSTV stations in all 50 states, but this novel means of communication is growing so rapidly that all states will soon be covered. In fact, a DX-ATV Centry Club (Worked 100 Countries) recognition is very possible within the next year.

The WAS-AT award will be made with adequate recognition and publicity to the various radio publications at the time of the presentation. The following rules are established for this DARA award:

1. Contacts must be made to all 50 states from the same transmitter location starting April 14, 1971.
2. Proof of the SSTV contact shall be a photograph taken of a readable received picture showing the contacted station's call letters or his symbol. In lieu of a photograph, a recorded tape (¼" audio) may be submitted, showing the received picture of the call letters or symbol.
3. A log shall also be submitted showing the station contacted, location, time and date, frequency used, and the type of video equipment of the contacted station. A statement shall accompany the log, stating that the contacts listed are in accordance with the regular station's log and that FCC rules have been complied with on all contacts.
4. Photos and recorded video tapes which are submitted, may be copied by the DARA for the record, but will be returned to the contestant after the award is made.



ULSTER COUNTY AWARD.

County Award. This certificate is issued by the Overlook Mountain Amateur Radio Club, Kingston, N.Y. for contacting amateur radio stations in Ulster County, New York. No time, mode or band limitations. DX stations (including KH6, KL7) must contact any two stations in Ulster County, N.Y., U.S. amateurs must contact three stations. Charge: 50 cents to W-K stations; 4 IRC's for DX stations. Send log data to Harold Twiss, WA2RXF, Country Lane, Lake Katrine, NY 12449.

in advance are $2; at door are $2.50. Children 5–12, 75¢. For raffles and tickets write to Eric Strassler WA2NLP, Ticket Chairman, 15 Crescent Ave., Passaic NJ 07055.

MASSACHUSETTS

The first Nobarc hamfest will be held August 22 at the Little Red Schoolhouse, Williamstown, Mass., 11:00 a.m. - 7:00 p.m. Activities include technical talks, demonstrations, transmitter hunts, YL demonstrations, family activities, flea market, and, displays. Talk-in on 146.94

MANITOBA B.C.

The eighth annual international hamfest will be held July 10 and 11 at the International Peace Garden. This hamfest is jointly aponsored by the Grand Forks, N.D. Amateur Radio Club and the Amateur Radio League of Manitoba, and is held annually in the beautiful Peace Gardens bordering North Dakota, U.S.A. and Manitoba, Canada. Activities include transmitter hunts, mobile displays, games, dancing, swap tables, prizes – fun for all with good camping facilities.

KELOWNA B.C.

The Penticton Civil Defense Ama-

Fred Basye (K5HOJ) is conducting the workshop entitled, "Ham Radio – Keeping Touch Around the World." CARF is also putting a station on the air during the convention July 6–9 with the sign K9IGB/5.

TEXAS

Swapfest & Picnic, Sunday, August 1, at the city park in Levelland, Texas. Sponsored by the Northwest Texas Emergency Net and the Hockley County Amateur Radio Club. This event is for the entire family. Bring your own picnic basket. Registration begins at 0930. Lunch at 1300. Caprock Repeater Club meeting at 1430. Mobile talk-in is the net frequencies: 3950, 146.94 FM, or through the Lubbock repeater on 146.34.

PENNSYLVANIA

The Foothills Radio Club, Inc. of Greensburg, Pennsylvania, will hold its fourth annual hamfest on July 11 at Wendel Ball Field, Wendel, Pa., 2.4 miles from the Irwin interchange of the Pa. turnpike. Over $600 in prizes plus 50/50 drawing. There will be check-ins on 10 and 6 meters. Refreshments at moderate prices and BINGO for the Ladies. Just follow the signs if you want to have fun in '71.

MICHIGAN

Cascades Amateur Radio Society announces its second annual swap-and-shop, Sunday, July 25, at the Jackson Armory, 100 Armory Court, Jackson, Michigan. Doors open at 8:00 a.m.; auction at 4:00 p.m. Donation: $1 in advance, $1.50 at the door. Table reservations are $1 ($1.50 for reserved table). Door prizes, free parking, many tables. Mobile talk-in on 146.94 FM and 3.915 MHz. For tickets, accommodations, or further information, contact Cascades ARS, Box 512, Jackson MI 49201.

fests have been very well attended by hams and others from several states.

OHIO

Mark Sept. 26 for the 1971 Cincinnati 34th Annual STAG hamfest, the one big STAG amateur radio event of the year. Meet all of your friends here. The event will be held at Stricker's Grove, Compton Road, Mt. Healthy, Cincinnati, Ohio. Door prizes each hour, raffle, lots of food, flea market, model aircraft flying, and contests. Identify "Mr. Hamfest" and win prize. $5 cost covers everything. For further details, contact John Bruning W8DSR, 6307 Fairhurst Ave., Cincinnati OH 45213.

INDIANA

This year the Original FM Hamfest is slated for the first Sunday in August, and it will be held rain or shine, according to members of the Fort Wayne Repeater Association, sponsors of the annual affair. The hamfest is to be held adjacent to Crooked Lake, where plenty of campsites and a nice park are available. A flea market is on the schedule, so load up the family and take your goodies with you. Head for Steuben Co. 4H fairgrounds – take 169, and go 3 miles south of the Indiana Tollway (Hwy 80–90). First prize will be a Regency HR-2 2m FM transceiver. Registration is only $1.50 per amateur, which includes a ticket for the main prize drawing. Talk-in frequencies .34/.76 repeater, .46/.88 repeater, .94 direct, and 52.525 direct – all FM, of course.

Indiana Radio Club Council's annual picnic Sunday, July 11th, La-Porte County Fairgrounds, LaPorte, Indiana. Large flea market with reserved locations available for large exhibitors and vendors on the midway and main building. Mobile FM clinic. Prizes. Tech sessions. For flyer write: Dave Osborn K9BPV, Box 272, La-Porte IN 46350.

5. Logs, photos, and tape shall be sent to WAS-AT Award, Dayton Amateur Radio Association, P.O. Box 44, Dayton, Ohio 45401.
6. Any question of contact authenticity will be submitted to an impartial committee, the members of which are not in the contest. Such members will be selected from the various net control stations of the Saturday SSTV Net which operates on 14,230 kHz at 1900 GMT.

The contest has already started, so start recording those SSTV contacts now.

ILLINOIS

The 14th annual hamfest of the Six Meter Club of Chicago Inc. will be held Sunday August 1 at the picnic grove on U.S. 45, 1 mile north of U.S. 30, 5 miles south of U.S. 6, Frankfort IL. Food and drinks will be available. Swap-and-shop section provided. Advance registration $1.50, admission at the gate $2. For tickets and further information contact Al Bagdon K9YJQ, 7804 66th Place, Argo P.O., IL 60501. Talk-in frequencies will be on 50.40 MHz AM and 146.94 MHz FM.

NEW JERSEY

The Knight Raiders VHF Club, K2DEL, will hold its 5th annual hamfest at Westbrook Park, West Milford NJ on Sunday, Aug. 15. Manufacturers' displays, gigantic flea market, contests, auction, 2m transmitter hunt, FM session, Navy MARS meeting, and a good time for all. Main door prize is the Drake TR-22 wm FM transceiver; other door prizes also. Big raffle for the Drake ML-2 2m FM transceiver; raffles are 3 for $1 and are avaiable now. Free beer, swimming, picnic tables, and barbeque pits available. Refreshment stand on premises. Talk-in Station K2DEL/2 will operate on 50.425 MHz AM, 145.71 MHz AM, 146.94 MHz FM using Drake ML-2 transceiver, plus operation on local Navy MARS repeater. Follow signs to hamfest site from Route 23. Tickets MHz FM, 50.4 MHz AM, WA1KFZ repeater 146.04/146.91 output FM, or WA1KGO repeater (146.34/146.94). Admission: $2 advance registration; $3 at the door per ham; family, YLs, etc.: Free! For details and advance registration, contact: Charles Doran, 240 North St., Williamstown MA 01267.

MONTANA

The annual WIMU hamfest will be held at Mack's Inn, Idaho, 23 miles south of West Yellowstone, Montana on U.S. 191. The dates are August 6, 7, 8th. Pre-registration is $3.50 per person before July 24th. Mail pre-registrations to Owen H. Wood WA7IZR, 407 North Main, Livingston, Montana 59047. Registration at the hamfest will be $4 per person.

TEXAS

Texas VHF-FM Society.
Date: The weekend of Aug. 14.
Location: Cibola Inn, Box 1145, Arlington TX 76010. U.S. Highway 80 near Collins Ave. Approximately midway between Dallas and Fort Worth.
Host: North Texas Repeater Association (an association representing FM repeaters around Fort Worth and Dallas).
Saturday events: Equipment displays, technical sessions, hospitality room, registration, fashion show and luncheon, then trip to Six Flags Mall for XYL's (tentative), visit to Six Flags Over Texas, caucuses as required to prepare for business meeting Sunday.
Sunday events: Business meeting, door prizes, raffle.
Cost: No registration fee. Amateurs attending will pay own cost of lodging, meals, and entertainment. Refreshments in hospitality room free. Raffle: Motorola HT-200 will be raffled. Motorola C & E is making the unit available at reduced price, Sentry Manufacturing Company is providing crystals free.

teur Radio Club is pleased to announce their sponsorship of the annual International Okanagan Hamfest in cooperation with the clubs in Kelowna, Vernon, and Kamloops. Motels, trailer, tenting and camping space are all available, as well as shower, washroom, laundry, small lake and pool with crystal water. There will be a giant auction, transmitter hunt, contests, and games for both young and old. Evening entertainment assured. A registration door prize and a big raffle prize. Admission for licensed OMs $3, YLs and XYLs $2; family ticket $5. Registration begins at 10:00 a.m. Saturday July 24. For further information contact Denny Warner VE7ASY, RR 4, Crawford Road, Kelowna, B.C. Canada.

FT. GEORGE AWARD

The Fort George Radio Amateur Club has made available an award certificate for all amateur radio stations making five contacts with any amateur station in the city of Prince George. These contacts are to be five *different* stations on any mode on any band. Logs should show date, time, mode and call of station worked and should be sent to: Fort George Radio Amateur Club, Box 835, Prince George, B.C., Canada.

CALI VI PAN-AMERICAN GAMES

All radio amateurs of America are invited to take part in the "CALI VI PAN-AMERICAN GAMES" contest. Only amateurs from the Pan-American countries are allowed to take part. Contacts are valid on the 15, 20, and 40m bands. The objective will be to contact as many stations as possible to get points:
Contacts with station HK5 CCP, 20 points
Contacts with station HK5 VD, 10 points.
Contacts with HK5 stations, 5 points.
Contacts with other stations, 2 points.

For further details write Liga Colombiana de Radioaficionados, Apt. 102, Cali, Colombia, S.A.

NEW PRODUCTS

ANTENNA NOISE BRIDGE

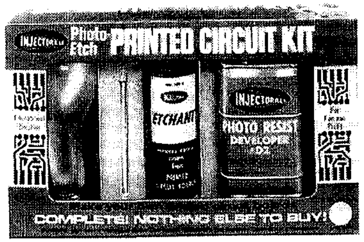
Higher frequency range amateur radio gear – including the popular 2m FM systems – can now be tested for resonant frequency and operation impedance with the Omega-t Systems Extended Range Antenna Noise Bridge. The unit combines precision and measurement flexibility normally found only in a collection of expensive laboratory equipment, according to Jack Finney, of Omega-t Systems. "We have previously developed a lower range antenna noise bridge, and now we are moving into high frequencies," he said. Able to be used over the entire range from 1 to 300 MHz, the bridge allows testing and tuning for optimum performance from an antenna and receiver without the use of additional equipment over the HF and VHF spectrum. It also replaces vswr bridges with a more accurate test system. *Omega-t Systems, 300 Terrace Village, Richardson TX 75080.*

QT-5 Continuous Tone Encoder

Alpha Electronic Services introduces the new QT-5 miniature solid-state subaudible continuous tone encoder, especially designed for use in the new amateur FM communications equipment. The unit provides an excellent, reliable method of repeater or multifunction control. The QT-5 is based on the same highly successful design concept used by Alpha for years

Now, with Injectorall's new No. 650 photo-etch PC kit, anyone, beginner or professional, can make professional printed circuits first time, every time. Injectorall's 650 is a completely packaged kit (nothing else to buy) using a photosensitive method for producing professional quality printed circuits. It can be used with assurance by engineers developing a prototype or a hobbyist constructing a home-lab project.

With Injectorall's Kit 650 you don't need a darkroom and you can completely eliminate commercially made boards. And if a magazine has a drawing you want to use, Kit 650 has materials included to let you make negatives from magazine circuits. Hobbyists and professionals alike have found it ideal for solid-state and integrated circuitry.



Kit 650 contains two photosensitized 3 x 4 in. copper-clad boards, a photographic test negative, and an ultraviolet light source. It also contains an exposure glass, clamps, developer, etchant, trays, resist remover, drill and complete instructions.

This low-cost easy way of making quality printed circuit boards is now available at all major distributors and retails for only $10.80.

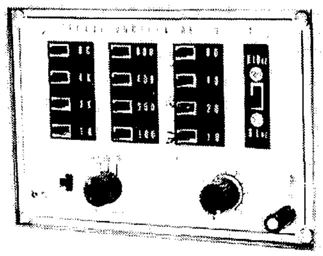
Hobbyist Tool Kit

A seven-piece hobbyists' tool kit – an ideal base upon which electronic hobbyists and kitbuilders can build

tor. The standard CM 41 series Tri-A-Lite is available with a choice of six different indicator colors and any long-life Chicago Miniature T-1 lamp. *Chicago Miniature, 4433 N. Ravenswood Ave., Chicago IL 60640.*

Miniature Sine/Square Wave Generator Gives High Accuracy at Low Cost

A miniature transistorized sine/square-wave generator, Model DF-24, is designed especially for exacting electronic work where high frequency accuracy is required, yet it is priced at only $65. Frequency range, in three bands, is 10 Hz to 166.5 kHz for sine wave . . . 20 Hz to 20.0 kHz for square wave. Frequency accuracy for sine and square wave is 1% + Hz, accured by the use of solid-state components and accurate calibration. Output signal amplitude is controlled by a variable attenuator with high resolution.



Weighing just over 2 lb, measuring 7 x 3 x 5 in. and requiring no external source of power, the unit may be used anywhere. Power is furnished by self-contained penlight batteries, giving low distortion and constant output . . . or, if desired, by any external 12V dc source. The unit is available from *Electronic Tools Division, C. H. Mitchell Co., 14614 Raymer St., Van Nuys CA 91405.*

NEW LITERATURE

SIGNETICS

Quantities of the popular "Applications Memos" handbook are once again available from Signetics, free for the asking. Containing approximately 400 pages, the 5½ x 7 in. paperback handbook contains an introduction to digital logic and discusses digital considerations by family, decoding and steering, counters, shift registers and memories, interface and display elements, linear considerations, timing circuits, and parallel data handling. All of these subjects are quite important to the electronic designer or amateur operator who may be unfamiliar with the ways in which integrated circuits may be used.

Furthermore, the experts who prepared the handbook at Signetics are available to answer your questions. Let them know if they can help you with information that might shed some light on integrated circuit technology.

TIME

TIME Corporation is offering a 12-page specification guide describing electronic laminates. The brochure is intended as an aid in specifying copper- or other metal-clad continuous-roll laminates for the printed circuit and flexible cable industry. In many cases these laminates are recognized as a major breakthrough in the printed circuit and flexible-cable industry because, for the first time, outstanding bonding agents such as epoxy adhesives and Teflon FEP, which ordinarily require long high temperature curing cycles, are continuously laminated.

Contact Vincent J. Sardo, TIME Corporation, Salem Industrial Park, Salem NH 03079, (603) 893-1661.

NATIONAL SEMICONDUCTOR

A new brochure describing Tri-State logic circuits is now available from National Semiconductor Corp. The 20 page document (TTL-5) describes the Tri-State logic circuit concept, its unusual characteristics and typical uses. Also included are descriptions and specifications for numerous Tri-State devices, including multiplexers, demultiplexers, flip-flops, line drivers, buffers, hexidecimal counter/latch, decade counter/latch and 256-bit read only memory. For a free copy, write to National Semiconductor, 2900 Semiconductor Drive, Santa Clara CA 95051, Attn: Marketing Services.

GC Electronics Catalog

A new general catalog has been published by GC Electronics (number FR-71-72) which lists over 14,000 products from all of the company's various operating divisions. The 312-page catalog includes complete listings for these GC divisions: GC Electronics, Walsco, Electrocraft, Magic Color, Telco, Audiotex and Calectro.

The catalog is the first totally new presentation of all its products turned out by GC Electronics in two years. It contains more than 1800 new items which the major American electronics manufacturer and distributor has added to its line in the intervening period.

GC Electronics product lines represented in the catalog include chemicals, servicing tools, printed circuit materials, servicing aids, automotive connectors and hardware, accessories, replacement parts, electronic hardware, replacement knobs and replacement antennas.

Under the "Walsco" trademark are chassis punches and a comprehensive grouping of replacement rubber belts, drives and pulleys for phonos and tape recorders. The "Electrocraft" line includes plugs and jacks, connectors, adapters, switches, cable clamps and ties. The "Magic Color" line consists

THIRD GENERATION OF MONOLITHIC OP AMPS

12th NEW JERSEY QSO PARTY AUGUST 21–22

The Englewood Amateur Radio Association, Inc., invites all amateurs world over to take part in the 12th New Jersey QSO Party.

RULES: (1) The time of the contest is from 1900 GMT Saturday August 21 to 0600 GMT Sunday August 22 and from 1200 GMT to 2300 GMT on Sunday August 22. (2) Phone and CW are considered the same contest. A station may be contacted once on each band – phone and CW are considered separate bands. New Jersey Stations may work other New Jersey stations. (3) General call is "CQ New Jersey" or "CQ NJ." New Jersey stations are requested to idnetify themselves by signing "DE NJ" on CW and "New Jersey calling" on phone. Suggested frequencies are: 1810, 3555, 3740, 3930, 7060, 7275, 14075, 14280, 21100, 21375, 28800 kHz, 50–50.5, 144–146 MHz. Suggest phone activity on the EVEN HOURS. (4) Exchanges consist of QSO number, RST, and QTH (ARRL Section or country). N.J. Stations will send county for their QTH. (5) Scoring: Out-of-state stations multiply number of complete contacts with New Jersey stations times the number of New Jersey counties worked (maximum of 21). New Jersey stations: W-K-VE-VO QSOs count as 1 point; DX stations count as 3 points. Multiply total number of points times the number of ARRL sections (including NNJ and SNJ – maximum of 74). KP4, KH6, KL7, KZ5 count both as 3 point DX contacts and as section multipliers. (6) Certificates will be awarded to the First place station in each N.J. county, ARRL section, and country. In addition, a second place certificate will be awarded when four or more logs are received. Novice and Technician certificates will also be awarded. (7) Logs must also show

Function Generator IC Produces Square Wave & Triangular Wave Simultaneously

A voltage-controlled oscillator of exceptional stability and linearity is now available in large quantities from stock for application in tone generators, frequency shift keying, frequency modulators, clock generators, signal generators, and function generators. This $6 integrated circuit is capable of performing all the operations of currently popular $300 function generators with equal precision and accuracy.

Designated the Signetics 566 function generator, the oscillator produces two outputs simultaneously: a highly accurate buffered square wave and a highly linear buffered triangular wave. Frequency is extremely stable (100 ppm/° C is typical).

Frequency of oscillation is determined by an external resistor, a capacitor, and the voltage applied to the control terminal. The oscillator can be programmed over a 10:1 frequency range by proper selection of the external resistance, and the device can be modulated over a 10:1 range with exceptional linearity by the control voltage.

'Jean' FG7XT Confirms 1st DXCC on RTTY

DX FOOTNOTES

This is Wolfgang Renner, YA1RG, and his new bride Hannelore. Wolfgang should be familiar to most DXers. He is, of course, one of the big guns in the famous Camel Drivers Radio Club in Afghanistan. From the photo, it should be understandable if Wolfgang is spending a little less time on the air.

One of the simpler ways to boost your countries worked total is to check into some of the DX nets currently active. At almost every check-in there are at least a few good ones ready to give you a new country. One net to look into is the Western Hemisphere Net on 7205 kHz at 0200 GMT. KP4CL is net control station.

For tougher DX there is the Arabian Net on Sautrdays at 1900 GMT on 14295 kHz. Some very rare Middle Eastern stations can be worked including JY, SU, and ST.

Those who are still looking for Swan Island (KS4) should be able to catch WA1ARF/KS4 on the YL-SSB net, 14332 kHz, on weekends. A as close to 7085 kHz as possible and listens around 7215 kHz between 0330 and 0400 GMT. QSL cards with an SAE and IRCs should be sent to LA3UF.

At the present time, the only legal, genuine, guaranteed for real, operator in Cameroun is TJ1AW. Charlie is a good operator and a fast QSLer. Cards go to Charles Thompson, YAOUNDE, Department of State, Washington DC 20521. Charlie, incidentally, is a life subscriber to 73 – and this is just about a guarantee that he is going to be on the air for at least the next 85 years.

ZM7AG, Jim in Tokelaus, keeps on appearing around 0400 GMT on the low end 20 meter sideband. He is often greeted with huge pileups, but he is getting adept at rapid QSYs . . . so be cagey and do a lot of listening and tuning around when you hear him. The anecdote is getting around DX circles that King Hussein, JY1, made a schedule with Jim in order to bag a new country for His Majesty's countries total. Jim forgot to keep the schedule! Don't you wish you were that rare?

If you are more successful than JY1, you can QSL via the International DX Association (INDXA), Box 125, Simpsonville MD 21150. An SASE speeds things up immeasurably.

RECIPROCAL LICENSING WITH JAMAICA

The Jamaica Amateur Radio Association and the Jamaican government announced the granting of reciprocal licenses between Jamaica (6Y5) and the U.S. The agreement has been in force since the end of April and the Jamaican government is already processing reciprocal license applications.

MORE NEW LITERATURE

New Transistor Substitution Handbook

TRANSISTOR SUBSTITUTION HANDBOOK, 11th Edition, by Howard W. Sams Engineering Staff. Although bipolar transistors are noted for their low failure rate, some of them do have to be replaced. As long as the specific type number required is readily available, replacement of the transistor is no problem because a duplicate of the original should be used whenever possible. All too often, however, the exact replacement cannot be obtained without considerable delay. Furthermore, the great variety of types available make it diffiuclt to determine which transistor can be substituted for the original.

Production of the new 11th edition of this book is possible because of the ability of modern-day electronic computers to handle a large quantity of information in a relatively short length of time. The computer selected the substitutes in this handbook in much the same manner that an individual would select a transistor replacement. The electrical and physical parameters as shown in the manufacturer's published specifications for each bipolar transistor were given to the computer, and then each transistor was compared with all the others. Over one billion comparisons of data have been made in the preparation of this book.

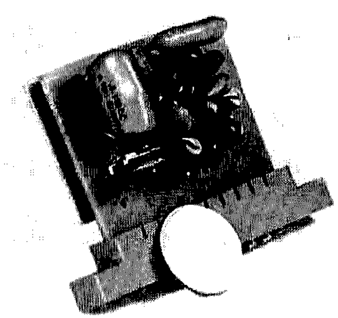
The transistors which matched within given limits are listed as substitutions. Representative types of American, European, and Japanese manufacturers of general-purpose replacement transistors.

A second section contains additional information on general purpose replacement transistors: the manufacturer, the polarity (NPN or PNP), the material (germanium or silicon), and the recommended applications.

The information in this handbook can be used by everyone concerned

throughout the commercial communications industry.

No mechanical reeds or relays are required and the frequency determining network is an integrated circuit, enhancing the long-term reliability and stability of the QT-5.



Available assembled and ready to install or in simple-to-build kit form, the unit will adopt to any FM transmitter, and a variety of installation instruction booklets have been prepared to make installation in specific radio models simple and fast.

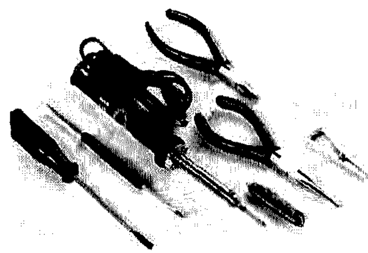
Tone frequencies are available in a wide choice of standard EIA frequencies from 67.0 to 203.5 Hz or even special frequencies if desired.

The QT-5 is fully compatible with Alpha's QT-10 decoder or any other standard subaudible tone decoder that meets EIA specification. Call or write *Alpha Electronic Services, 8431 Monroe Ave., Stanton CA 90680.*

PC Kit Aids Beginner or Professional

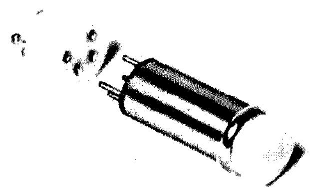
At one time building an electronics project was hard work for it involved drilling, cutting, reaming and deburring a metal chassis. Some of those early chassis weren't aluminum either, but steel; and so electronics construction meant sore muscles, cut and bleeding fingers, and frazzled nerves.

Injectorall Electronics Corp., Great Neck, N.Y. has taken the sweat out of electronics and put pleasure back in. their tool needs – is a featured item in GC Electronics' new catalog.



The tool kit consists of long-nose and diagonal cutting pliers, screwdriver, soldering iron, soldering aid tool, heatsink tool, and a coil of rosin-core solder – the most-needed items for the hobbyists' tool chest.

Marketed through GC Electronics' Calectro Division, the tools are blister packed for store rack display. The kit is designated catalog number H3-378 and retails for $7.95. *GC Electronics, Div. of Hydrometals, Inc., 400 South Wyman St., Rockford IL 61101.*



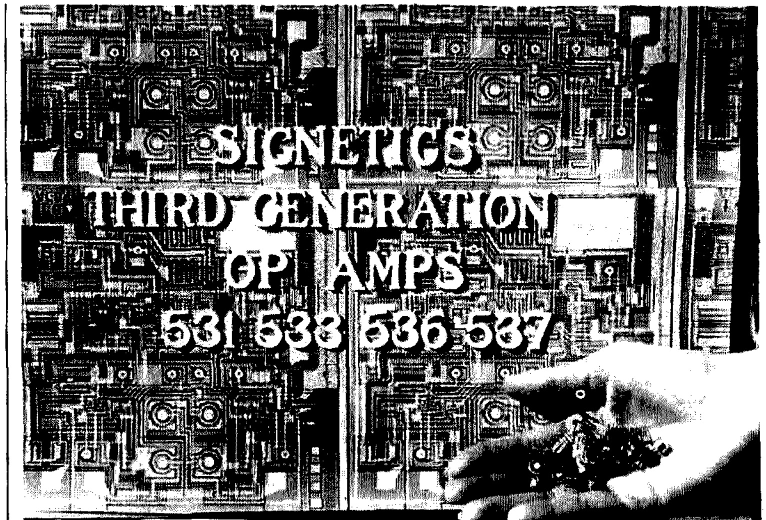
Three-In-One Indicator Lights

The CM 41 series Tri-A-Lite, an exclusive Chicago Miniature design, appears white in the off position and takes on color only when an input voltage is applied to one of its number-coded contacts.

By providing three different colors in a variable sequence, the Chicago Miniature CM 41 Tri-A-Lite takes the place of three separate indicators. The CM 41 Tri-A-Lite color sequence is variable with positioning of the mounting pin configuration, and can be predetermined by the user through coded pins and a companion connec-

of outdoor and indoor TV antennas of all types, couplers and splitters. Antenna installation hardware comprises the bulk of the "Telco" product line.

GC Electronics Division of Hydrometals, Inc., manufactures and distributes a full range of electronic parts, hardware, accessories, chemicals and supplies for service technicians, engineering labs, hobbyists, consumers and industry.



The electronic industry's "third generation" of operational amplifiers, a family of four new linear integrated circuits, has been developed by Signetics Corp. and is now available in quantity from stock. The announcement was made by Paul Kollar who is in charge of marketing the company's standard linear products.

"We define the 'third generation' as the next line of operational amplifiers that will solve specific problems without sacrificing performance, ease of use, or standard pin arrangements," Mr. Kollar said. "Our devices eliminate the major headaches usually associated with state-of-the-art op amps, and they achieve a new level of performance.

First Generation: 1964

The first generation of operational amplifiers was the 709, which appeared in 1964. It was the first useful linear integrated circuit, and it simplified many of the problems that engineers faced in designing analog systems.

Second Generation: 1968

The second generation of op amps appeared in 1968 in the form of the 101/741 devices. By providing input and output protection, simplified compensation, and better specifications, these newer devices eliminated the major problems that were associated with using the 709 op amps.

Since the introduction of the 101/741 devices, designers have tried to give operational amplifiers tighter specifications, but the new units were not easy to use. High slew rate operational amplifiers like the 715 achieved faster speeds, and low-power op amps like the 735 drew less current, but they sacrificed dc stability, ease of compensation, and output protection, the very features which made the 101/741 so popular.

Operational amplifiers with FET (Field-Effect Transistor) inputs, such as the 740, offered much promise but few performance guarantees. Input current specifications were not as good as those for existing low-offset precision op amps. Precision op amps like the 108 offered specifications that were attractive to designers, but they sacrificed intput protection, standard output drive, and offset null.

Third Generation: 1971

The third generation of op amps is being introduced with a family of four new devices: 1) the Signetics 537 precision op amp with extremely low input offset and bias currents, 2) the Signetics 536 general purpose, high performance op amp that uses a high-impedance field-effect transistor (FET) input stage, 3) the Signetics 533 high performance op amp which consumes only 100 microwatts of power at ±3V supplies, and 4) the Signetics 531 high slew rate op amp.

Precision "Punchthrough" Op Amp

"The Signetics 537 is a punchthrough op amp, which has the same parameters as the LM108 and LM108A," Mr. Kollar said, "except that our 537 has a maximum differential input voltage of ±30V and the other two devices have a maximum differential input of only 1V. Such a low differential range severely limits the 108's usefulness and makes it susceptible to damage by transients. Why pay for ultraprecision but with no input protection and substandard output drive?"

With standard pinout compatible with the 101/741, the Signetics 537 is packaged in a 8-pin TO can.

"Our 536 is a FET-input op amp," Mr. Kollar said, "that does what op amp design experts said couldn't be done – that is, achieve offset voltages approaching those of general purpose devices and input currents comparable with hybrids. Specially selected 536 units can be supplied which will meet the 7.5V offset specified for the 101 and 748."

GMT date and time, band, and emission, and be received not later than September 18, 1971. The first contact for each claimed multiplier must be indicated and numbered and a checklist should be attached. Multioperator entries should be noted and calls of participating operators listed. Logs and comments should be sent to Englewood Amateur Radio Association, Inc., 303 Tenafly Road, Englewood, New Jersey 07631. A size #10 SASE should be included for results. (8) Stations planning active participation in New Jersey are requested to advise the EARA by August 7th of your intentions so that we may plan for full coverage from all counties.

NEBRASKA QSO PARTY

The Lincoln Amateur Radio Club Inc. of Lincoln, Nebraska announces the 1971 Nebraska QSO Party.

DATE – TIME:

Starts 0000 GMT Sept. 5

ENDS 2300 GMT Sept. 6

FREQUENCIES: 3560– 3982
7060– 7260
14060–14300
21060–21360
18060–28560

QSO EXCHANGE: Nebraska stations; give signal report and county. All other stations; give signal report and state.

SCORING: Nebraska stations; 2 points for each QSO, each mode. Multipliers are each state, each province, and each country. All other stations; 3 points for each QSO, each mode. Multipliers are each Nebr. county. Mobiles in a different county count as a separate QSO and multiplier.

BONUS SCORING

FOR ALL PARTICIPANTS!!!!!

The Lincoln Amateur Radio Club will be operating KQØNEB at the Nebr. State Fair from Sept. 1 to Sept 9. Any contact with KQØNEB during the fair week will count for points in the QSO party, regardless of whether it is during the QSO party. The scoring for working KQØNEB as follows: 10 points each contact, each mode. Also count as a separate multiplier. If KQØNEB is worked at least once on four separate bands, add 1000 points to total score.

Certificates will be issued to the high score in each Nebr. county, high score for each state, province, and DX country. Other certificates will be issued where deemed necessary by the Awards Committee.

To be considered for a certificate, all logs must be sent to the Awards Chairman, Michael Nickolaus, 4921 Tipperary Trail, Lincoln, Nebraska 68512, by October 15, 1971. Logs must be in GMT. Final score must be indicated on a summary sheet. Enclosed business size envelope S.A.S.E., for a copy of the results.

Jean Wegimont, FG7XT of Guadaloupe, became the first ham to make DXCC on RTTY. Jean has actually worked 110 countries, but it took WBØAAB on May 1, 1971, to send his QSL to make one hundred countries confirmed. Congratulations are in order for a real achievement in ham operating.

IOWA

The annual Iowa 75 meter phone net picnic will be held on Sunday, August 15, at Riverview Park in Marshalltown, Iowa. All amateurs are invited. There will be a swap table and nice prizes to be given away. The festivities will start with a potluck dinner at noon with the remainder of the festivities occurring Sunday afternoon.

NEVADA

The Annual Sierra hamfest will be held on Saturday, Aug. 14, at the California Bldg. in Idlewild Park, Reno, Nevada.

particularly good time to look for him is 0130 to 0200 GMT on Fridays. On Saturdays try the same frequency from 2100 GMT onward. This should be a good catch for those who still don't have their Advanced tickets. All QSLs for WA1ARF/KS4 should go to WA6MWG.

MP4MBB in Muscat has a new beam which is reportedly helping him put in a much stronger signal into the U.S. He can generally be found Wednesdays at 2330 GMT on 14218 kHz.

Skepticism is accompanying the appearance of 1A1A. However, those who did not work KD3UMP and C21AA thinking they were bogus, are now among the supporters of Gus, W4BPD, when he says to "Work 'em first and ask questions later."

Italian stations are now using the new prefixes. Italian stations can use the first digit in the Italian version of the Zip Code in their prefix. The only problem being with the area in Northern Italy whose delivery unit begins with "1". In the Piedmont area they can use IP1. Also some of the islands can use special prefixes with Sardinia becoming ISØ and Sicily IT9. There are also other island prefixes running from 1A5 to 1MØ. During the weekends in May you may run across 1BØKDB operating on the band edge on twenty SSB. QSL for this one to Box 143, Palermo, Sicily.

Due to civil strife all ham activity in Ceylon (4S7) has been stopped and the government is reported to have confiscated all ham gear for "safekeeping."

UJ8AC, Tadzhik, is often found on Saturdays between 0200 and 0400 GMT above 14200 kHz.

CR3DN should be on the air now from Portuguese Guinea where he is stationed for the next two years. QSLs should be directed to CT1BH.

TA3AC, Turkey, looks for U.S. stations on 80 and 40. He transmits as close to 3780 kHz as QRM allows and listens on 3805 kHz between 0400 and 0500 GMT. On 40, he transmits

QSL INFORMATION FROM THE W2NSD/1 DX HIDEAWAY

Cards for ZF1WF and 7Q7AA are now being handled by K4CDZ. QSLs for KG6SW go to W7YBX, for VK9FH to WØKHI, and for WA8FPN/KS6 to WA6BKS. The latest QTH we have for HS3AFB is Box 4954, APO San Francisco CA 96288. YB3AAY can be QSLed to Jess Marino, U.S. Embassy, Surabaya, APO San Francisco CA 96356. Cards for KB6CT go to the Federal Electric Corp., APO San Francisco CA 96401. F9MS is QSL manager for FR7ZU/E, /G, and /T. He requests a self-addressed envelope and 3 IRCs.

Jim Vaughan, K4TXJ, has written to 73 to say that he has become QSL manager for Jack, ZS3KC, in Swakopmund, Southwest Africa. Jim's QTH is 5504 Datura Lane, Louisville KY 40258. The usual SASE would be appreciated.

You can QSL Sam, MP4TDM in the Shaikdom of Ras Al Khaimah, through K2DRN, Vernon Damerson, 265 Davis Rd, Beford MA 01730. A SASE is essential for U.S. stations and a SAE and IRCs is essential for DX ops who want the MP4TDM card.

Those who worked Kevin, ZK1BM, while he was on Cook Island, should send their cards to W7VRO.

KW6HA cards should go to Gary Davey, 349 Sanford St., Leucadia CA 92024.

Anybody with information on DX operations, QSL managers, or the like, is invited to send it in to 73. Anybody who sends in a good picture of any DX operation which we eventually publish gets a free year of 73 (it could be worse, it could be two years). Just send in your comments and photos to DX FOOTNOTES, 73 Magazine, Peterborough NH 03458.

with transistor replacment – be it in industrial, commercial, or home-entertainment devices.

TRANSISTOR SUBSTITUTION HANDBOOK, 11th Edition, Catalog No. 20835. Size: 160 pages; 5½" x 8½", softbound. List Price: $2.25 ($2.85 in Canada).

Allied/Radio Shack Catalog

Described as the "first and only catalog of its kind," Allied Radio Shack's new Spring/Summer 1971 Electronic Parts, Accessories and Kits Catalog No. 212 is a handy buying guide for the builder, hobbyist, fix-it man, experimenter, or anyone wanting a full selection of electronic parts, accessories, maintenance items and kits.

The 116-page catalog includes thousands of hard-to-find or specialized items like tubes, transistors, cables, tools, connectors, wire, plugs, adapters, antennas and test equipment. It also lists many exclusive products, and previews Allied Radio Shack's line of Knight-Kits and Science Fair kits for 1972.

Catalog 212 is available free on request from Allied Radio Shack, 2725 W. Seventh St., Fort Worth TX 76107.

Allied Radio Shack, a Tandy Corporation Company (NYSE), is the world's largest chain of consumer electronics stores. The company has more than 950 stores in 49 states.

"KA NET" CHANGES

Tokyo, Japan . . . The Far East Auxiliary Radio Leage (FEARL) has announced a frequency and time change for the "KA Net." Beginning in July, the net will meet twice each Sunday at 0001 GMT and again at 1200 GMT. The net frequency will change to 14.300 MHz. Net call will remain, "CQ Ka Net."

FEARL, sponsor of the "KANet," is composed of amateur radio licensees assigned to United States Forces, Japan.

LETTERS

Old Ads

Enjoyed the 50-year old ads on p. 97 this month. Hope you'll run more of them.

Ron Wyllys
465 Caromar Dr.
Madison WI 53711

Excellent idea on the 50 year old ads – would like to see more of them.

Joseph F. Dineen W1JSS
9 Winter Terrace
Westwood MA 02090

Russia

I was just on a trip to Moscow and Leningrad. Couldn't locate a single Societ ham! My guide didn't even know what I was talking about. Any suggestions in case of future trips??

Lee Barnes
132 Starlite Drive
San Mateo CA 94402

Drop a note to Box 88, Moscow and tell them you plan to be there . . . and watch for the Red carpet.

. . . Wayne

Two Points

Two subjects:

Referring to the first question on page 80 of May 73 Magazine (Questions, Questions), the answer given states that FM has worse signal-to-noise ratio characteristics than AM or SSB. This may or may not be the case depending on the basis of comparison. This is clearly pointed out in an article that appeared in Vol. 3, #5 of FM Magazine entitled *How Does FM Stack Up?*, and in standard textbooks on communication theory (for example see Chapters 5 & 6 of "Communication Theory: Transmission of Waveforms and Digital Information," by D. J. Sakrison). Both the FM article and confirming the accuracy of my forecasts.

John Nelson

Beginner

I have been buying 73 for the past four months and I like it a lot. I am trying to decide whether to subscribe or not. I would subscribe in a minute if I could be sure that there would be something for the beginner in each issue. Sure, the first thing I'll do when I get my General is to get on 2 meter FM and all, but right now all I'm interested in is getting my Novice. 73 is my favorite magazine but I get no help from it right now. I am 15, just starting out in radio, and sure need all the help I can get. Thanks a lot.

Mike Lonas
1020 Karenwood Dr.
Maryville TN

We've got some excellent series slated and plenty of good beginner articles in the works. Keep reading!

. . . Ken

No Study Course

Just a note to inquire why the General Class License Study Guide did not appear in the April issue? If it was there, I could not find it. In 7 articles, you have covered 28 of the 52 questions in the FCC list. Please keep up the good work.

F. C. Van Widden WA5FF3 (Tech.)
607 E. Oklahoma St.
Weatherford OK 73096

April was FM month. The General series is back now, though.

. . . Ken

Outmoded

Shades of the U.S. Army and my many years of operating FM with and without repeaters. I was rather disappointed in the magazine when it was discovered that it exalted an archaic means of communication. When I received my last discharge from the Army I hoped that I would never again have to use, read or listen to this dated mode again. To have a magazine

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor. . .

6 METER FM (postpaid): RT-176/PRC-10 transceiver, $30; RT-70/GRC transceiver, $30. Also T-150, $40; 300 watt gasoline AC generator, $32.50. WB4GEW, CPO 2183, Berea KY 40403.

REALISTIC TRANSMITTER BARGAINS: Johnson Valiants $89; Johnson Factory Wired Valiant with Johnson SSB Adaptor $189; Many More. Get Complete Listing. Stan Burghardt WØIT, Box 73, Watertown SD 57201.

MILITARY SURPLUS. 12PDT 24V dual 400 ohm coil, relay 95¢. Silicon dielectric grease 8 oz. tube, $1.45. 10 pound surplus assortment, $4.00. All new and postpaid USA. Catalog on request. Electronic Systems. P.O. Box 206, New Egypt NJ 08533.

MECHANICAL FILTERS: 455 Khz Center Frequency. 2.1 Khz. $18.95. 300 Hz $22.95. J.A. Fredricks, 314 South 13th Avenue, Yakima WA 98902.

SWAN 270 with Swantenna, Shure 404C mike. Year old. $390.00, you pay postage. WN6OOK, 409 Beverly Drive, Redlands CA 92373.

MOTOROLA X53GTV-10, 4 xmit, 2 rcvc, $100. 2 GE high band, MA36W – 4 xmit, 3 rcvc – MA/E36B, 4 xmit, 4 rcvc, $110. Ca. All accessories except ovens. You pay shipping. R. Eckton, 1021 W. Cedar, Redlands CA 92373.

DUAL-GATE MOSFET 2-METER PREAMP. PC construction, 18 db gain, 3 db NF typ. Fully wired and guaranteed, only $13.95 ppd in U.S. Mich. res. 4% sales tax. HALE ELECTRONICS, 803 17th St., Bay City MI 48706.

73 MAGS OCT 1960 THRU DEC 1969 National 2 Meter FM BASE RX & TX BEST Offer. W3YB, 580 Durham Rd., Penndel PA 19047.

RD-112 CW INKING RECORDER. 0–350WPM. Uses standard 3/8" tape. 115v–60Hz. Great for making visual copy of CW. Used Good $125. – TV-10B Tube Tester $65.00. Mike Tewksbury, Box 8324, Norfolk VA 23503.

VHF SELLOUT: Ameco TX 62 $89; Gonset GC105 $69; Johnson 6N2 Transmitter $69; Swan 250C/TV2B/117CX $549; Swan TV2B New $229. More Items. Get Complete Listing. Stan Burghardt WØIT, Box 73, Watertown SD 57201.

MANUALS – $6.50 each: R-390/URR, SP-600JX, CV-591A/URR, URM-25D, LM-21, URT-7, BC-639A, UPM-45, UPN-12, FR-5/U, FR-38/U, BC-779B, OS-8C/U, ARR-7. S. Consalvo, 4905 Roanne Drive, Washington DC 20021.

TRADE: GT550, AC supply, vox, calibrator. Perfect condition. Interested in T4XB or SB220 or best cash offer. Jim Fleming, 7528 Brynmawr, Chicago IL 60631. 775-8179.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland CA 94607, 451-7755, area code 415.

SELL: 73 Magazine $1.00 per year. Hoehner Melodica w/music $5.00. Greystone 20 volume Encyclopedia of Photography. (Cost $80) $20.00. Koss Pro 4A headphones $15.00. Stephen Clifton WA2TYF, 800 W. End Ave., New York NY 10025.

NEW SIGNAL-ONE, CX7, unopened carton, warranty, latest model. Sell/trade, want Collins, Drake. Don Payne, K4ID, Box 525, Springfield TN 37172. Days (615) 384-5573, nights (615) 384-5643.

SELLING OUT WAREHOUSE full of teletype and facsimile machines, parts and equipment. Loads of electronics. No fair, reasonable offer refused. Weekdays 10–4, Saturdays & Sundays by appointment. C. G. Goodman Co., 5826 S. Western Ave., Chicago IL 60636. Phone 312-GR-6-8200.

FM HAMFEST SUNDAY AUGUST 1, NEAR ANGOLA, INDIANA. Big prizes, free flea market, entertainment for the ladies and kids. Picnic grounds campsites, boating, food, soft drinks available, rain or shine. Call in Freq. 146.34/146.76, 146.94, 52.525. For information contact Fort Wayne Repeater Assn., Box 6022, Fort Wayne IN 46806.

CRYSTALS for Regency, Varitronics, Drake, & Galaxy transceivers and for police monitors. Receive – $4.50 postpaid; Transmit – prices vary – write. One week delivery. Derrick Electronics, Box 457, Broken Arrow OK 74012.

CINCY STAG HAMFEST: Attention hams; Mark this date, Sept. 26, for the 1971 Cincinnati 34th Annual STAG Hamfest, the one big STAG Amateur Radio event of the '71 year. Meet all of your friends here. More details later. W8DSR, Hamfest Secretary.

FOR SALE: Gonset sidewinder–2 mtr. SSB, CW & AM transceiver with a.c. power supply, & manual. Excellent condition. $195.00. Gonset d.c. supply (new) $50.00. W1VYB

the text point out that FM has better signal-to-noise characteristics than AM or SSB when the bandwidth of the FM signal is increased. The improvement in S/N of FM over SSB is proportional to roughly the FM bandwidth squared. The FM Magazine article states that in comparing a 15 kHz deviation FM signal with either AM or SSB, the transmitting power being equal, FM is clearly better by a significant margin (27.6 dB difference in S/N provided that the FM signal is above threshold).

I will be set up shortly to operate FM on the 80–10 meter bands. Admittedly, I will have to limit the bandwidth to comply with FCC rules and therefore can't take full advantage of the capabilities of FM. I am looking for stations that desire to experiment with FM on these bands to see what the effect of QRM etc. is. If anyone is interested in participating in such experiments, I would appreciate a letter from them.

H. Stanley Staten WA7IKJ/NØPWS
545 University Village
Salt Lake City UT 84108

Those of us who have used narrowband FM on the lower bands in years gone by found that the major problem with it was the lack of FM detectors on receivers. FM does not stack up with AM and SSB when slope detection is used. Since there seems to be no prospect whatever of getting FM detectors built into amateur lowband receivers, there is little prospect for successful use of NBFM on these bands.

. . . Wayne

DX Forecasts

The May issue of 73 has a letter from Bill Peterson K9OWQ saying that I used to forecast VHF-DX but do not do it anymore. He wants to know how come. It is true, I used to forecast VHF-DX but I quit because I did not have proper data to use for research purposes and I had no way of that calls itself a ham magazine devote so much of its effort to FM puzzles me. Why not rename it *FM, a magazine dedicated to the elimination of tuning controls,* or *The Senior Citizens Band FM Journal – a magazine dedicated to channelized communications.*

Joe Wimmer W6RPX

Because there are probably already magazines using those names.

. . . Ken

Encroachment

In the past year the Raritan Bay Radio Amateurs (R.B.R.A.) have been approached and asked if 146.460 MHz can be used as a repeater input channel. The R.B.R.A. has been on .460 for 15 years with 24-hour monitoring by club members. Could you publish the fact that 146.460 is active in the Sayreville, New Jersey area.

Mark Dzuban WB2IRX
329 Lee Ave.
New Brunswick NJ 08902

We'll publish the info, but we suggest you get your net to go over to FM. Stay on 146.46 and use the repeater for check-in. You'll be using the frequency you want in the mode for which it has been adopted as a national channel. Nobody loses!

. . . Ken

Stolen Rig

I would really appreciate it if you would print the following information: Somebody stole my Heathkit HX-30 6 meter sideband exciter (serial no. 6233), a Dow-Key DK-60 relay and a Turner SSB+2 mike. The sideband exciter is the piece of equipment which is most easy to spot because of the serial number but maybe the guy who ripped it off from me will also try to fence the mike and the relay at the same time.

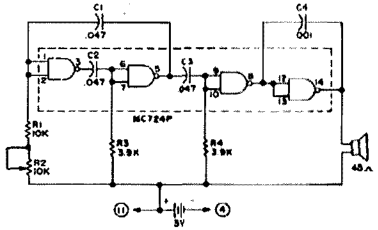
At least they didn't steal my back issues of 73. Those are irreplaceable, y'know.

Any information concerning the stuff should be sent to me (WA1IVB) or the Stoughton (Mass.) Police.

Norman B. Blake WA1IVB
23 Oriole Rd.
Stoughton MA 02072

IC "8-Transistor" Oscillator

I had some trouble building the code oscillator (Sessions, March 1971); keying was unreliable. I made some changes, and the overall operation was improved. Operation was made a great deal more reliable and keying is very consistent. Here is my modification:



Stan
5204 Penelope Lane
Knoxville TN 37918

RADIO BOOKSHOP BIG DEALS

BOOKS!

ADVANCED CLASS STUDY GUIDE Up-to-the-minute simplified theory, written with the beginning radio amateur in mind. This unique book covers all aspects of the theory exam for the Advanced Class license and has helped hundreds of hams to sail through the exam . . .nothing else like it in print.
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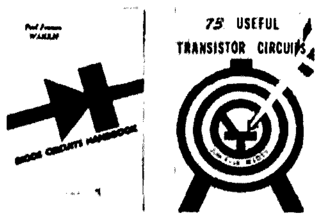

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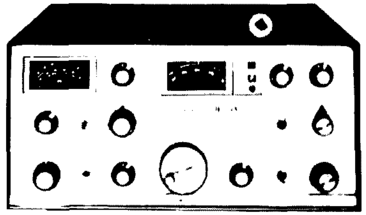

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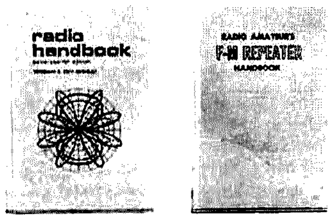

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An IC Audio Processor

To write about another type of speech compressor and still, yet, to call it an "ultimate" type may seem a bit overdone at a time when speech compressor circuits of every variety are commonplace. But the unit to be described is by no means just another garden-variety speech compressor.

The phrase "audio processor" as used in the title, may, on the other hand, seem a bit nondefinitive, but it has been used to indicate that the unit provides a far more useful function than just speech compression alone. In fact, it is meant to convey the idea that it has processed a speech waveform on an af basis to such a degree that the waveform is the best possible to be fed to a transmitter for full modulation.

The unit makes use of two ICs an SL630 amplifier and an SL620* automatic gain control unit. The two ICs were designed to mate together for a speech processing function and, therefore, should be used together even if one is tempted to replace the relatively simple amplifier IC by another type of IC.

The complete schematic of the unit is shown in Fig. 1. The unit is designed for both a low impedance input and output and a matching transformer is necessary for use with a high-impedance microphone. Usually, no transformer is needed on the output even if it is connected to a high-impedance audio input on a transmitter because of the amplitude of the output voltage. The input provides either for a

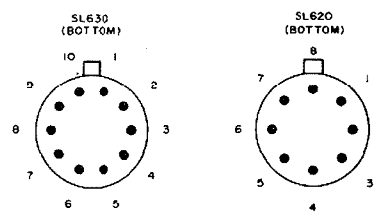
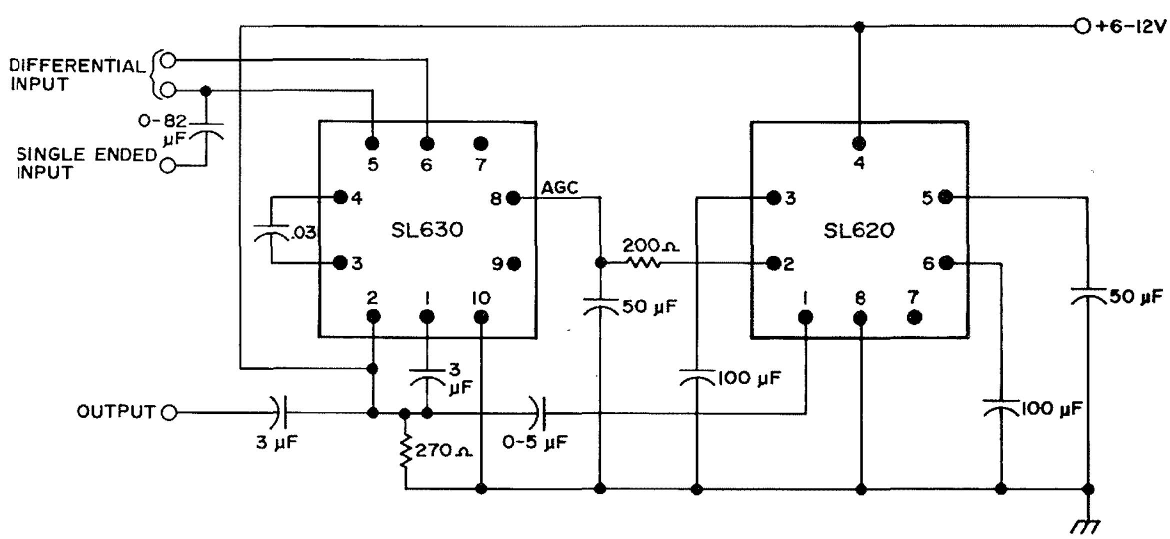


Fig. 1. Complete schematic of the IC audio processor.



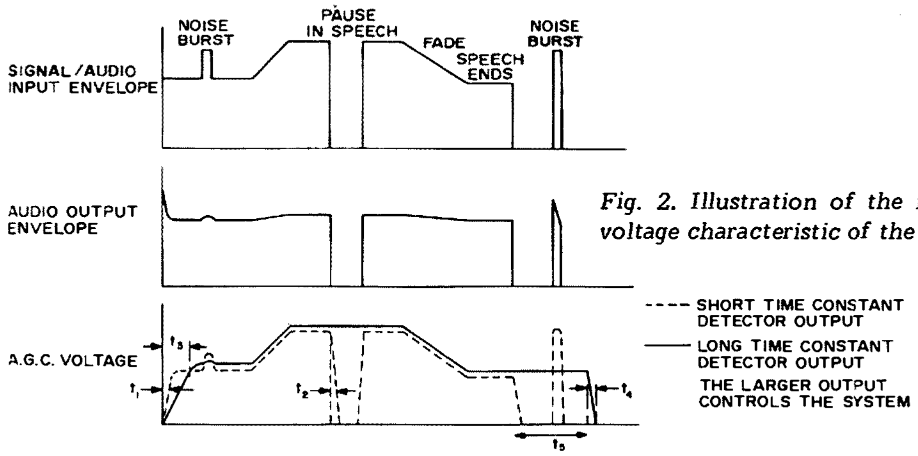


Fig. 2. Illustration of the input/output and agc voltage characteristic of the processor.

balanced or an unbalanced type of microphone input. The former can be quite useful since by having both microphone leads ungrounded, many problems with noise pickup, rf pickup, etc. on the microphone leads are automatically avoided. If the usual type of unbalanced input is used, however, it is connected to pin 5 of the SL630 via a 1 μF capacitor. Pin 6 is then left unconnected. The capacitor between pins 3 and 4 of the SL630 provides a high-frequency rolloff characteristic. The values shown provide a rolloff starting at 3 kHz, but this can be changed, if desired, by experimenting with the capacitor value.

The output is taken from pin 1 of the SL630 via the two 3 μF coupling capacitors. Part of this output is coupled to pin 1 of the SL620 IC via the 0.5 μF capacitor. The SL620 IC uses this voltage to generate an agc voltage which is eventually available at pin 2 of the SL620. From there it is coupled to pin 8 of the SL630 to control the gain of the latter IC. What these two little ICs can accomplish is shown nicely by Fig. 2. The upper curve shows a varying speech input, while the second curve shows how the audio output appears after processing. Notice that when the speech input either rises rapdily or falls rapidly the output remains essentially constant. Noise bursts, because of their much shorter time duration, are recognized separately by the unit. The noise burst shown occurring during speech, although much higher in amplitude than the speech level, produces practically no increase in output. An automatic squelch feature is also provided. When there is a pause in speech, the output is disabled to prevent the background noise buildup common to most simple compressors. The pause time before the output is disabled is about 1 second and can be changed, if desired, by varying the value of the capacitor from pin 6 of the SL620 to ground.

The control range of the unit is illustrated by Fig. 3. Only a very slight change in agc voltage is necessary to control the output over a 60 dB range. In practice, the input can change over a 35 dB range and the output level will remain between 70 and 87 mV.

Construction

The photograph shows how the author constructed a unit on perforated board stock. The parts layout is in no way critical and is just a matter of convenience. The photograph of the underside of the board is just shown to illustrate how easily the unit could be adapted for etched PC board construction as a club project since only one wire crossover is necessary and even that can probably be eliminated by experimenting with the parts layout.

The units will operate equally well with a 6 or 12V dc supply and draw up to about 15 mA. The operating voltage can be borrowed from a well filtered point in a transmitter or a battery supply used. In the latter case, a usual 9V battery is ideal to use. There are no controls to the unit and so it may be housed easily inside a transmitter, avoiding only any location near high rf fields.

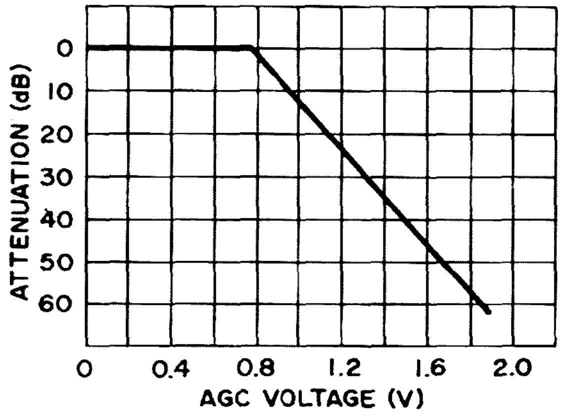


Fig. 3. Control range of the unit excees 60 dB. The graph illustrates the control of the input signal by the SL630 with agc voltage supplied by the SL620.

Operating Results

I compared operation of the unit to several types of conventional audio compressors. In every case, the unit described exhibited a much smoother compression action without pops, clicks, etc. It simply sounded more like the type of quality speech processing found on commercial circuits rather than the usual harsh, noisy compressor type action, which usually has to be disabled for local contacts because the inherent distortion then becomes so noticeable. The squelch and noise immunity features added also a great deal to the cleanliness of the speech output and should be particularly useful in a mobile type situation where a great deal of extraneous background noise can exist.

The IC Internals

The circuitry of the SL630 audio amplifier is not too different from that of many IC audio amplifiers, except that it includes provision for agc control of its output over a wide range. The input is coupled to a differential amplifier directly without the use of coupling capacitors for a balanced input. The agc voltage (pin 8) controls the emitter current flow return for the differential amplifier via the transistor whose base goes to pin 8 and a 3.6 kΩ resistor. The 750Ω resistor between base and collector acts as a "linearizing" element to give the smooth control range shown in Fig. 3. The rest of the unit continues to provide amplification (40 dB overall), ending in a series-connected output pair, which can provide an output up to 250 mW if the unit were used as solely a power amplifier device. Unlike many ICS, however, the necessary bias resistors and capacitors to suppress parasitic oscillations are all included in the unit, thus saving many external components. Pin 7, marked "muting," can be switched to ground to disable the audio output. If manual control of the gain of the unit were desired (instead of by the SL620 unit), a potentiometer can be connected between pins 9 and 2 with the wiper arm going to pin 8.

The circuitry of the SL620 unit, on the other hand, is quite different than most ICs because of its specialized functions. T1 through T4 are the input af amplifiers. The af output is coupled to a dc output amplifier (T16-T19) by means of two detectors (T14 and T15). T14 in conjunction with CI has a short rise and fall time constant. T15 in conjunction with C2 has a long rise and fall time constant. Thus, any input signal will rapidly initiate agc action via T14 (in 20 ms), but after a longer time (200 ms) T15 takes over to control the agc. The effect is rapid initial agc response but not false agc response to sudden peaks after the speech input has started. T6–T8 form a trigger circuit which detects sudden peak inputs above 4 mV, such as noise bursts. When such a burst occurs during a pause in input it prevents via T10 and T13 the output from being turned on.

T9 in conjunction with C3 forms a sort of memory circuit having a time constant of about 1 second. So long as a speech input is present, it does not act but during a pause exceeding one second, C3 discharges to turn on T12 via T11 and turn off the audio output of the SL630/SL620 combination. The capacitors mentioned above for the various time constants, CI, C2, and C3, are external to the IC and their value can be experimentally changed to suit individual preferences. W2EEY■

**If units are not available locally, write to Plessey Microelectronics, 170 Finn Street, Farmingdale, L.I., NY for location of nearest distributor.*

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AUDIO SIGNAL GENERATOR

An audio signal generator is a handy item when checking audio gear, and an af oscillator is a lot more consistent than whistling into the mike – especially if you're snacking on peanut butter sandwiches. The oscillator described here is the answer. It's inexpensive, simple, and can operate from subaudio to rf.

The oscillator basically is a modified Wien bridge using complementary FET and bipolar transistors. Analysis of the Wien bridge of Fig. 1 shows the bridge is balanced when

$$f = \frac{1}{2\pi\sqrt{R1R2C1C2}} \quad \text{and} \quad C2/C1 = R3/r - R1/R2.$$

When C1 = C2 and R1 = R2 and the frequency is such that $R = X_C$, the impedance $Z2 = \frac{R}{\sqrt{2}} \angle{-45^\circ}$ and $Z1 = R\sqrt{2}\angle{-45^\circ}$.

Consequently, a third of the voltage applied to the bridge between points A and D appears across Z2. When R3 = 2r, one third of the voltage applied to the bridge appears across r, so there is no difference of potential between points B and C, and the bridge is balanced.

In the actual oscillator shown in Fig. 2, R4 and R5 in parallel make the resistance r of Fig. 1 for ac. The reactance of C3 must be less than 10Ω at the frequency of oscillation. R5 is the resistance of a 6W 120V lamp whose positive temperature coefficient regulates the output of the oscillator and insures that signals within the oscillator are not clipped or limited.

A typical 6W 120V lamp has a resistance of 200Ω when the voltage across it is 0.1V rms, and about 550Ω when the voltage is 3V rms. A good operating point is about 0.5V, or a resistance of about 300Ω. The actual operating point is determined by R3 and the particular lamp's characteristics. The larger R3, the higher the lamp operating voltage.

R3 is chosen to be slightly greater than twice the lamp's resistance when the voltage across the lamp is about 0.5V rms, and a value of 680 is about right. Initially, then, the bridge is unbalanced, and oscillations will start when power is applied. The ac voltage across the lamp increases the lamp resistance and brings the bridge toward balance. The bridge is brought to the balance point, which produces a bridge attenuation exactly equal to the amplifier's gain. The attenuation, the ratio of applied voltage (A to D) to output voltage (B to C), is infinite at true balance, and an infinity-gain amplifier would be required. Therefore, the oscillator must operate with some unbalance.

The match of R1 and R2 and C1 and C2 is very important and, although the circuit given can handle 5% tolerance components, a closer match is desired so that greater variations in lamp, amplifier gain, and loading can be tolerated. Loads heavier than 1 kΩ can best be accommodated by adding an emitter-follower buffer on the output of the oscillator.

Matching C1 and C2 can present an interesting problem if you don't have access to a good bridge. The technique I used was slow, but it was a starting point. First, I matched a pair of resistors in the

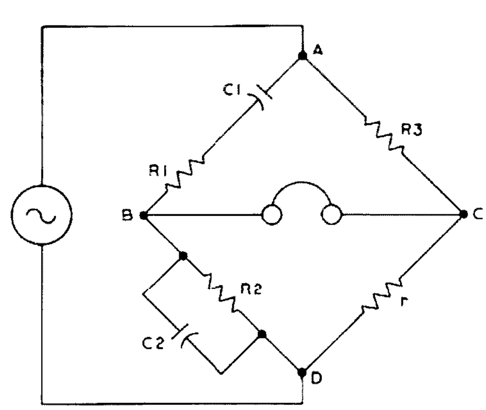

Fig. 1. The basic Wien bridge.

Freq. kHz	C1, C2 µF	R1, R2, kΩ
.250	.01	63.4
.400	.01	39.2
1.0	.01	15.8
1.8	.001	88.7
2.5	.001	63.4
10	.001	15.8

range of 270 kΩ with an ohmmeter and used them in the bridge shown in Fig. 3 to match the .01 µF capacitors. At the start, you won't know which of the capacitors is smaller, so shunt one of them and note whether the balance improves. Add to the one that improves the null, and try to balance within 2%. In matching the .001 µF, the bridge resistors should be in the order of 2.7 MΩ and a VTVM is essential for detecting the null.

Values of R1 and R2 between 2 kΩ and 1 MΩ and values of C1 and C2 above 470 pF are convenient. Within these bounds, these combinations are available:

The same general circuit approach can be used to make a wide-range variable frequency oscillator. In the variable oscillator, fixed resistors R1 and R2 are replaced with sections of a dual pot. If the tracking of the pot sections is within 5%, the circuit could be used directly, and a 100:1 tuning range could be achieved, but it isn't very likely that you will find such close tracking.

There are two possible solutions to the difficulty. One reduces the tuning range by adding fixed resistance in series with the variable resistances to reduce the percent-

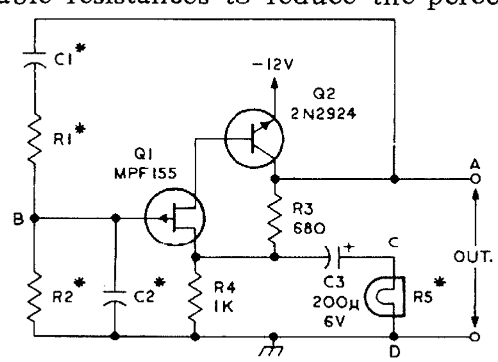

*Fig. 2. Fixed frequency oscillator. All resistors 10% ¼W. *See text for values and tolerance.*

age tracking error, and the other increases the gain of the amplifier so the unavoidable unbalance can be tolerated. In the oscillator shown in Fig. 4, both solutions are used. R_{ab} adds about 2.5 kΩ in series with each of the 100 kΩ pot sections and reduces the tuning range, and Q3 makes a higher voltage gain possible from Q2. The oscillator tunes from about 150 Hz to 6 kHz for the values given.

The pot R_{ab} is adjusted to minimize the percentage difference between R1 + R_a and R2 + R_b as the dual pot is rotated fully clockwise. The power supply for the oscillator is not critical, and any voltage from 12–24V will do for the fixed-frequency oscillator, but the variable frequency oscillator should have a supply above 18V. The current required for the fixed oscillator is about 5 mA without a buffer, and the variable oscillator requires about 18 mA.

The layout of the oscillator is not particularly critical for audio frequencies, but care should be taken to shield the high-impedance sections from power-line pickup. If an external power supply or batteries are used, the normal enclosure will be sufficient. The variable oscillator of Fig. 4 will fit in a minibox if an external power supply is used. The heft will be improved if you bolt a chunk of scrap steel into the bottom of the box.

If you prefer, you can change the polarity of the unit by making these direct substitutions: MPF 155 to MPF 104; 2N2925 to MPF 6518; 2N3638 to 2N2923. Don't forget to change the polarity of the electrolytics. The heavy negative

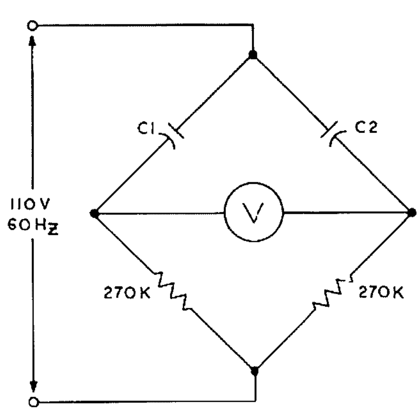

Fig. 3. Capacitor comparison bridge.

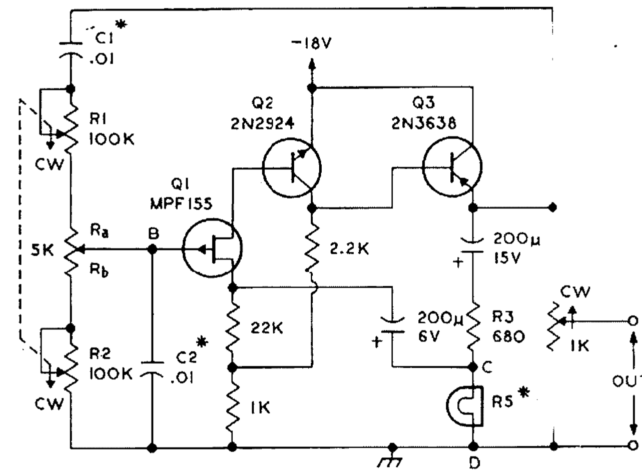

*Fig. 4. Variable frequency oscillator. All resistors 10% ¼W. *See text for tolerance.*

feedback makes the circuit very tolerable of component variations, but the following table of DC voltages may be comforting when you turn the oscillator on for the first time:

Fixed Osc.	Emitter (Source)	Base (Gate)	Collector (Drain)
Q1	- 4.5	0	-11.4
Q2	-12V	11.4	- 7.5

Var. Osc.	Emitter (Source)	Base (Gate)	Collector (Drain)
Q1	- 4.5	0	-17.4
Q2	-18.	-17.4	-14.4
Q3	-18.8	-14.4	-18

An evening or two and a few bucks for parts are all that are needed to build the oscillator. If your junkbox is like mine, full of everything except what you need, it will cost you under $6 to buy all new parts for the fixed oscillator. A pair of these little gems operating at 400 Hz and 1.8 kHz are ideal for generating the signals for adjusting the SSB rig, and you can enjoy your peanut butter sandwich too. . . .W3SGV■

Reference:

Edson, William A: Vacuum-Tube Oscillators, New York, John Wiley & Sons, Inc., pp. 128, 138 to 142, 1953.

Terman, Frederick Emmons, Sc.D: Measurements in Radio Engineering, 1st ed., New York, McGraw-Hill Book Co., Inc., pp. 46, 47, 1935.

The MPF155 ($1.30), 2N2924/HEP 724 (95¢), and 2N3638 (50¢) are available from: Circuit Specialists Co., Box 3047, Scottsdale AZ 85257. Please include 25¢ for shipping.

questions questions questions

Herbert S. Brier W9EGQ
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We do not normally devote as much space to answer one question as we give to our first question this month. But telling anyone how to protect himself and his visitors from the dangers of uncontrolled electrical currents is important enough to command additional space.

I am almost afraid to touch two pieces of equipment in my electronics shack at the same time, because doing so is almost like playing Russian Roulette. One time, I get a nasty shock; the next time, nothing. And when I disconnect or connect an antenna or piece of equipment, sparks often fly, even though all power switches are shut off. Are these things dangerous? How do I correct the trouble? Yes. The conditions you outline are dangerous. Almost any electrical shock can kill under the proper circumstances. Fortunately, however, eliminating the hazards is not difficult. The basic problem is that the primary circuits of virtually all electronic devices operated from the commercial power lines are bypassed to their metal chassis and cabinets through capacitors. Consequently, the cabinets are effectively coupled to the power line via the bypass capacitors. If the cabinets are grounded, however, the resulting alternating currents are harmlessly drained off into the ground. But if the ground is omitted, and you simultaneously touch a cabinet and a grounded object, your body becomes the ground path. Depending on the capacitance of the bypass capacitor and whether it is leaky or shorted, the result may be a slight tingle or a truly shocking experience. The sparking that occurs when you connect your antenna to your equipment is a probable indication that the antenna is grounded somewhere either by design or by accident. Conversely, many a technician has had his teeth loosened by a shock while working on an ungrounded antenna left connected to a receiver, transmitter, or transceiver. Incidentally, an actual ground connection is not needed to get a shock between two pieces of electronic equipment. Suppose that only one side of the power line is bypassed to the chassis in either unit (a common condition), dependihg on how the power plugs are inserted into the ac power sockets, one bypass capacitor may be on the "hot" side of the power line, and the other capacitor may be on the "ground" side of the line. As a result, there will be a voltage difference between the cabinets of the two units.

To solve the problem, connect all metal cabinets to a low-resistance ground with heavy flexible wire. The best ground *for this purpose* is the ground post used by the utility company in your home. In addition to the ground straps, always make certain that the equipment is completely disconnected from the power lines before connecting or disconnecting anything (including grounds) from it. Usually the easiest way to insure this is to pull the power plug from the power socket. The worst way is to depend on the power switch in the unit.

Can I change the crystal filter in my Heathkit HW-100, amateur SSB transceiver to the Heathkit SSB crystal filter? If possible, what would I gain from the exhange? The filters are interchangeable. In fact, if you purchase a new Heathkit HW-100 kit and return its crystal filter in its unopened box with $20 to the Heath Company, and order the SB-102 SSB filter – part number 404-283 – the company will ship you the new filter and a few cents change. Replacing the HW-100, 4-crystal filter in the HW-100 with the SB-102, 6-crystal, SSB filter makes the HW-100 SSB selectivity equal to the SB-102 SSB selectivity. An SB-102 filter without a trade-in costs $37, by the way.

I acquired a bargain bag of transistors, some good and some bad. How can I weed out the bad ones without a transistor tester? An ohmmeter that develops no more than 1.5V across its open test leads and allows a maximum of 1.0 milliampere to flow between the test leads when they are shorted together will identify open and shorted transistors, but higher voltage or current may damage a delicate, low-power transistor. The procedure: Measure the resistance between the transistor base and collector; then reverse the ohmmeter test leads and repeat the measurement. Note the difference between the two readings. Next, make a similar pair of measurements between the transistor base and emitter. If either pair of readings show a very low meter reading that does not vary when the ohmmeter test leads are reversed, that junction is shorted. Conversely, if the reading is high and unchanging, the junction is open. In either event, the transistor is defective. But if there is a difference between the readings in each pair, the chances are good that the transistor is usable. Some power transistors, especially germanium types, may show fairly low leakage resistances; but, as long as there is a perceptible difference in readings when the ohmmeter leads are reversed, the transistor should be usable. Do not leave the ohmmeter connected to the transistor any longer than necessary to obtain a meter reading.

My old, old shortwave receiver from the Goodwill shop brings in the stronger overseas shortwave broadcast stations, but it is not sensitive enough to bring in the weaker ones clearly. Is there any attachment I could get to bring in these weaker signals? A preamplifier between the antenna and the receiver antenna terminal should amplify weak signals three or four S-units. If you don't want to build your own preamplifier, look up the AMECO PCL-P, all-band preamp.

Your questions will be answered here to the limit of the space available. Send them to: Questions, 73 Magazine, P.O. Box 678, Gary IN 46401.

. . .W9EGQ■

Dipper Thing

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Have you ever wished your grid dip meter were more accurate at higher frequencies or had the capability of going lower in frequency than the 3 MHz range that seems to be so popular on most units?

For some time I have been using a simple detector lead in conjunction with an rf generator for grid dip purposes. The probe is inexpensive and easy to construct and use. It utilizes an inexpensive movement which is available from most mail order houses under the title of "light meter movement." The cost is usually about a buck and a half and is typically a 45 μA (basic sensitivity) meter. The sensitivity is not critical; however, something in this range is necessary for an indication which is easily seen. A VOM or other similar indicator can also be substituted at some sacrifice in compactness and operating convenience.

In place of the standard rf generator lead, which usually incorporates a 50Ω or 75Ω terminating resistor, connect the detector lead shown below.

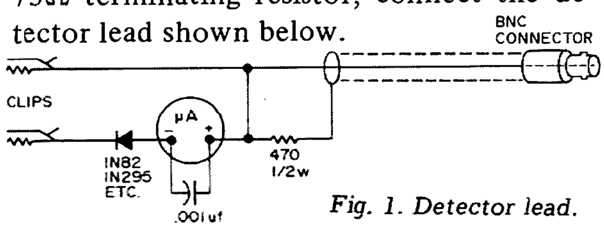


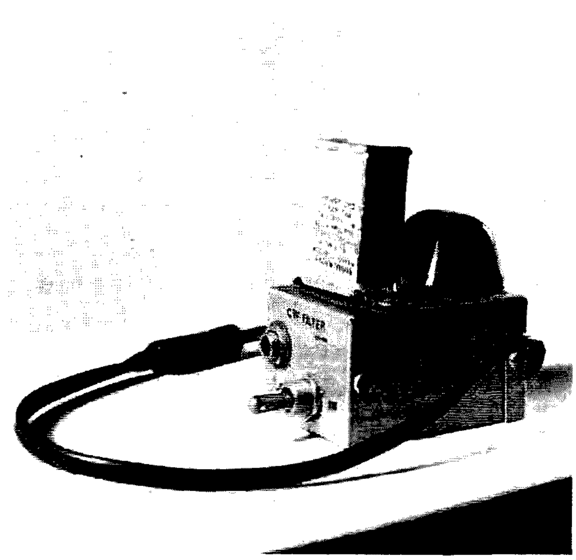
Fig. 1. Detector lead.

My probe has a BNC connector on one end and miniature alligator clips on the other. The components are mounted on the rear of the meter and this assembly is secured to the clip end of the lead with a good cement such as GE's RTV compound. Direct connections may be made to the circuit or a two-turn loop may be connected at the clips for inductive coupling to the circuits to be dipped.

You may now dip circuits whose low frequency limitation is governed by the output of the particular rf generator and the meter sensitivity. No problem has been encountered using the third harmonic of 48.3 to tune circuits in the 145 MHz range.

. . .WB4MYL■

A Filter Box for CW Ops.



Dennis J. Lazar K8TSQ
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The kid knew, long before entering the shack, that the Old Man was working on 80 CW. Halfway down 73rd Street his transistor radio had begun to thump rhythmically. A few irate neighbors – audiophiles no doubt – could be seen glaring from windows or standing about on front porches muttering ominously as radios whined and hissed in stereo behind them.

The young Novice entered through the side door, cautiously making his way down the open wooden stairs. He descended into a dim, musty abyss. The feeble light invading the cellar through high casements barely penetrated the heavy tobacco smog.

The Old Man sat hunched before the controls of his powerful station. Dextrous fingers skillfully manipulated the paddle of an electronic keyer while the sweet music of The Code filled the basement gloom.

The kid stood watching in awed silence as dits and dahs followed fast upon each other's heels in machine gun staccato. The OM was truly a master of the ether, spanning thousands of miles with the controlled lightning at his command.

At last, with a crisp "dah dit dah," the OM "turned it over" to his distant contact. He sat back, puffing hard on his pipe, as the phones came alive. The distant station op was no slouch. His fist was crisp and clean. Moreover, there was little background noise and virtually no QRM. The signal had a clear, bell-like ring to it, quite unlike anything the kid had ever heard before. Thus, he knew instinctively that the OM had added something to his gear. But what?

He hopped up onto a high stool beside the bench and gave the equipment a quick onceover. The receiver was as he had seen it last. No preselector or Q-multiplier was in evidence.

Then his roving eyes stopped, fixed upon a tiny box placed at the end of the table. It was connected by a length of cord to the receiver's earphone output. Mounted on the box was a jack into which the OM had plugged his earphones. "What... why...how...?" The kid began, nudging the OM and pointing.

"Shhhhhh, wait a minute, George is turning it over to me." Relays clicked, transformers hummed as the big rig went on the air.

Not able to copy at 30 wpm, the kid picked up little of the ensuing conversation. He did, however, catch the 73 and the SK. The QSO was over.

"Ok, what is it?" he demanded.

"What is what?" The OM turned to face his young companion and would-be protege.

"That little box you're plugged into," the kid replied, pointing. "What is it?"

"Oh, why, that's an audio filter. For CW, you know."

"What does it do?"

"Well, let me show you." The OM

unplugged the filter from the receiver's earphone jack. He then plugged the phones directly into the receiver and tuned to the 40 meter Novice band. A bedlam of sound cascaded from the headset.

"Put on the cans and tune in a station," the OM instructed.

Obediently, the kid sat down putting the phones to his ears. He soon found a medium strength KN7 amid a multitude of stations vying for the frequency. "Okay," he said. "What now?"

"I simply insert the filter into the line like so." The OM inserted the proper plugs into the proper jacks. "Now, what do you hear?"

"Wow!" the kid exclaimed after a moment. "There's only one signal in there. All the others are much weaker."

"Ha – now watch this!" The OM flipped a toggle on the box.

The kid tuned the receiver slightly. "This is terrific. All I hear is the KN7, and nothing else!"

"Whenever you tune a CW station so that the beat note is a 750 Hz audio tone, the filter will let it through. All other tones will be blocked."

"Fantastic!" The kid eyed the tiny box. "What's inside?"

"Oh, just a couple of coils, a few capacitors, and an amplifier module."

"But what makes it tick?"

"Why, resonance, of course. It's a simple tank circuit, but resonant at an audio frequency instead of rf."

"I know a tank circuit is what you tune when adjusting a transmitter, but I don't really see the tie-in. I guess I really don't understand how a tank works."

"Okay," the OM sighed, "make yourself comfortable and let me begin at the beginning.

"Tank circuit is a term used to describe a parallel resonant circuit. These circuits are composed of two elements, an inductor (a coil) and a capacitor. Resonance in a tank circuit is possible due to certain properties of coils and capacitors."

"You mean inductance and capacitance, right?"

"Right. Now, do you know the difference between voltage and current?"

"Sure," the kid exclaimed, "I did pass the Novice exam, didn't I?"

"Okay," the OM smiled, "tell me about it."

"Well, er – current is the flow of electrons through a wire and voltage is the force pushing it. It's like water in a pipe; the amount of water in gallons running through the pipe each second would be the current and the pressure in pounds pushing it would be the voltage. . .right?"

"Fine, now we can get into explaining resonance. First, let's talk about inductance."

Inductance

When current flows through a coil of wire, it produces magnetic lines of force surrounding the coil. As long as current flows, the magnetic field remains constant. But, when input flow ceases, the field collapses. This collapsing magnetic field cuts across the windings of the coil causing a new current to flow. This induced current flows in a direction opposite to that of the input current.

When alternating current (Fig. 1) flows through a coil, a magnetic field builds and collapses with each change of polarity. When ac is initially applied, voltage and current flow in each turn of the coil. A magnetic field builds up around that turn, inducing voltage in the following turn. The induced voltage is in opposition to the input voltage. Thus, as voltage builds during the first alternation of the ac cycle (ABC) the coil tends to oppose the flow of current.

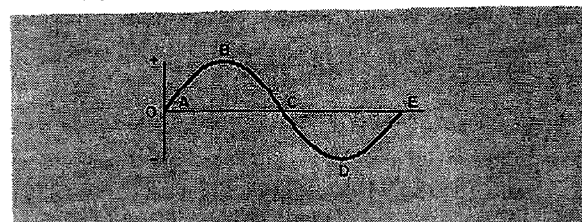

Fig. 1. Alternating current waveform.

As shown in Fig. 1, current reaches its peak at B and begins to decline. The magnetic field collapses, inducing a voltage in the coil. This voltage is in opposition to the second alternation (CDE) and will thus resist current flow.

Resistance to change of current flow in a coil is called inductance. The effect was first described by German physicist Heinrich Lenz (1804-65). Lenz states: "Whenever a current is set up by a change of magnetic flux through a coil, the direction of the induced current will be such as to oppose the current which produced it."

Inductive reactance is the value in ohms of a coil's ability to oppose alternating current.

Capacitance

A capacitor consists of two conductors, or plates, separated by an insulator, the dielectric. Materials commonly used as plates in capacitors are metal foil and solid metal plates. Dielectric materials include air, ceramic, mica, and impregnated paper.

Capacitors function as storehouses for electricity. In Fig. 2, a battery is shown charging a capacitor through a switch. When the switch is closed, electrons flow from the negative battery terminal to capacitor plate A. At the same time, electrons flow from plate B to the positive battery terminal. As electrons gather on plate A it becomes negatively charged. The shortage of electrons on plate B causes it to become positively charged.

In the first instant following the closing of the switch, a heavy current flows, with electrons rushing to plate A and away from plate B. Little voltage is needed to force current through the circuit. Plate A soon becomes crowded with electrons and the electron supply at plate B becomes depleted. Current flow slows. More voltage now becomes necessary to keep electrons moving. With decreasing voltage drop across the capacitor due to decreasing current flow, circuit voltage increases. A point is reached at which capacitor voltage equals applied battery voltage. Current flow ceases. The capacitor now is fully charged. If the battery were removed, the capacitor would retain a portion of its charge for hours, or even days. The capacitor may be discharged by shorting across its terminals with a condcutor. Current will flow from the negative to the positive terminal until both plates have an equal electron supply.

If ac voltage were applied to a capacitor, the first alternation would charge the capacitor as shown in Fig. 2. The next alternation would discharge the capacitor, recharging it in the reverse direction.

Fig. 2. Capacitor charged by battery.

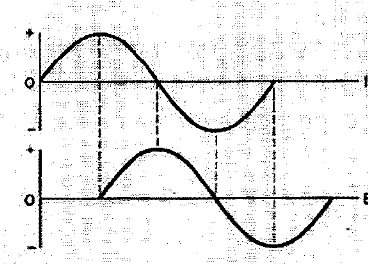

Fig. 3. Current lags voltage by 90° in an inductor.

Electron flow is to plate A and away from plate B during the first half-cycle (AB, Fig.1). The capacitor holds this charge until the second half-cycle (CD) causes electrons to flow to plate B and away from plate A.

With alternating current applied, a capacitor appears to be a closed circuit. Current flows in the circuit as if it were actually passing through the capacitor.

The amount of current that a capacitor can store is determined by its size, nature of its plate area, distance between plates, and the type of dielectric used. The capacitor thus limits or opposes current flow in a circuit. This phenomenon is called capacitive reactance and is measured in ohms.

Reactance

In a resistor, current is opposed by the material of which the resistor is composed. Power is dissipated as heat and thus is lost from the circuit.

Capacitive and inductive reactance also represent opposition to current; however, they consume no power.

Inductance of a coil is measured in *henrys*. Capacity of a capacitor is measured in *farads*. In both cases, the value of re-

actance (the ability to oppose the flow of alternating current) is measured in *ohms.*

Because alternating current flow in a coil causes an induced voltage which opposes current change, there is a phase difference between current and voltage, with current lagging. (Fig. 3). If the coil were pure inductance (having no resistance), current would lag voltage by 90 degrees. Resistance of the wire causes this phase difference to be smaller.

Capacitors also cause a phase difference between voltage and current. This is due to the reversal of polarity across the capacitor with reversals of the alternating current. In a capacitor, the current leads the voltage by 90 degrees. (Fig. 3). This phase angle would also be diminished by resistance.

It can be seen from Fig. 3, that while an inductance tends to oppose a change in current, a capacitance tends to oppose a change in voltage.

In any circuit containing both inductance and capacitance, the total effect on the circuit of these two influences will be the difference between their values.

Resonance

When inductive and capacitive reactance become equal in a circuit, a condition of resonance is said to exist. Resonant circuits can be designed to select or rject a certain frequency or group of frequencies.

Resonant circuits can be constructed in either of two configurations: series or parallel. A tank circuit is a parallel resonant circuit.

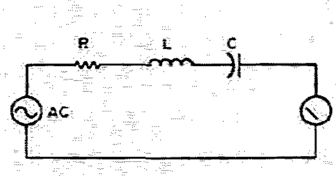

Fig. 4. Series LCR circuit

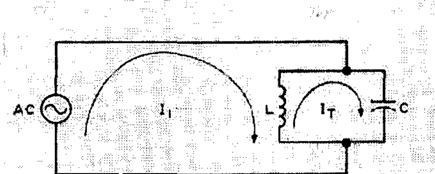

Fig. 5. Parallel LC circuit.

Series Resonance

To facilitate ease of understanding, let us look first at series resonance as shown in Fig. 4. At a given frequency, ac voltage in the circuit causes L and C each to have a reactance according to its value. If we change the input frequency, reactance values of L and C also will change. The value of **R** (pure resistance in the circuit) always remains constant. The difference in reactance between L and C thus represents an opposition to current flowing in the circuit. By adding this reactance value to the value of pure resistance, we arrive at the total circuit opposition to alternating current at a particular frequency. This value is called *impedance* (Z).

Assuming L and C to be some fixed value, we can find a frequency at which inductive and capacitive reactances will be equal. At this frequency the reactances, being opposite in nature, will cancel each other. Current flow in the circuit will be opposed only by R.

Looking at the circuit in Fig. 4, it can be seen that at the resonant frequency, the ammeter (I) would read a maximum current flow. At all other frequencies the reading would be lower. The circuit, in effect, allows current at one frequency to pass while impeding current of all other frequencies.

Parallel Resonance

When a capacitor and coil are wired in parallel (Fig. 5), the combination will be resonant at a frequency determined by the values of L and C. With the circuit at resonance, little signal current flows. This is because at resonance, a parallel LC circuit acts as a storage device (hence the name tank circuit). Signal energy is interchanged between capacitor and coil at a rate equal to the signal frequency. The interchange of energy, once initiated, continues nearly independent of additional signal current. The capacitor, charged by the signal, discharges into the coil. The collapsing magnetic field of the coil generates a reverse voltage which recharges the capacitor. Since the input signal established the initial charge on the capacitor, the

circuit will accept little additional signal current. Thus, at resonance, signal current is very low while tank current is very high.

A parallel LC circuit at resonance, then, acts in a manner opposite to that of a series resonance circuit. At the resonant frequency, impedance for the signal current is very high, allowing little current to flow in the circuit. For all other frequencies, the impedance is very low. Thus, at resonance, a parallel LC circuit represents a large voltage drop. Current flowing through a high impedance creates a large voltage drop across that impedance. A signal current flowing in a circuit containing an LC circuit at resonance would thus result in a signal voltage appearing across the LC tank. If the signal was not at the tank's resonant frequency, little signal voltage would be dropped across the tank. In this way, a tank circuit acts as a filter, allowing a voltage output only when a signal at the resonant frequency is applied.

"So there you have it," said the Old Man. "Capacitance, inductance, reactance, resonance, the whole bit." He stretched and began to rise.

"Say, wait a minute," the kid blurted, coming out of a semi-doze, "you forgot something, didn't you? What about the box?"

"Oh yes, the filter."

"From the lecture you just gave me I assume there are coils and capacitors inside. But how did you manage to squeeze in all the components and how does the IC tie in?"

"All right," the OM sighed, "let's start by opening the box and also by looking at the schematic."

CW Audio Filter

As most hams know only too well, CW operators, especially those using the Novice band segments, are a long-suffering lot. There are QRN and foreign broadcast interference to contend with, to say nothing of adjacent-station QRM due to crowded bands. Rarely is a contact completed without at least one station issuing a strident CQ only a few cycles from the frequency in use. Many a good QSO has ended in frustration, fading away into this constant background din.

There is a simple and inexpensive solution to problems brought on as a result of too many stations occupying too little band space. An audio filter, selective enough to single out a discrete audio note, can make a nearly impossible snarl sound like code practice.

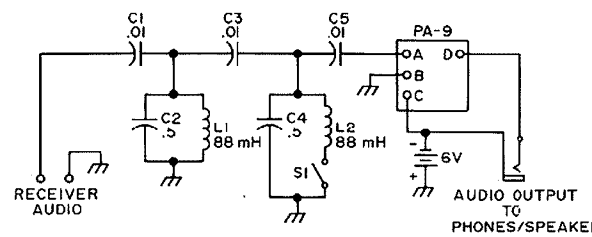

Fig. 6. Schematic of CW Audio Filter.

The Circuit

The audio filter is based upon three major components: A pair of toroidal coils which combine small size and high inductance, and a solid-state audio amplifier module.

Receiver audio, consisting of CW signals of many different audio frequencies, enters the filter through coupling capacitor C1 (Fig. 6). Capacitor C2 and coil L1 comprise a tank circuit resonant at 758 Hz. This tank will shunt to ground signals that are not at the resonant frequency. A 758 Hz signal will cause signal voltage to be developed across the tank. This signal is coupled through C3 to the top of tank circuit C4–L2. If switch S1 is closed, off-resonance signals are further attenuated. With S1 open, the second filter circuit is disabled and the signal passes directly to C5. The function of S1 is to provide two levels of selectivity for ease of tuning.

From C5, the filtered signal enters module PA-9 where it is amplified to drive headphones or speaker. Volume of the input audio from the receiver determines output volume of the amplifier.

Filter output frequency may be changed to suit the ear of the individual. Some may desire a lower tone, some a higher pitch note. By changing the value of C or L, the

resonant frequency of the filter may be altered.

Components

Voltage ratings of the components are not important in this circuit. Receiver audio voltage never will approach usual component ratings. Capacitors may be disk ceramic or any other type found in the junkbox or surplus electronics store. If size is no object, an economical substitute for the two 0.5μF capacitors is a surplus double oil-filled type. Most have flanges for chassis mounting.

Coils are toroids, available through many sources. You may come across them advertised for sale in the classified section of this magazine. Toroids often are used in Teletype equipment as filters to differentiate between two audio tones that carry RTTY information.

PA-9 is a "public address amplifier module" available through Lafayette Radio Electronics Corp., either locally or by mail order ($3.50). Address of the company is Box 88, Syosset, LI, NY 11791. Higher powered, higher priced modules are readily available from many sources where more audio output power is desired.

The battery may be of any type, considerations being size versus life.

Your preference is the rule here.

Construction

A minibox, a few terminal lugs or strips, a soldering iron, drill, and a screwdriver will get you through this project in fine form. The device, however, need not be built in a minibox. You can breadboard it or even build it right into your receiver.

Toroids are sold centertapped with these leads open. You must solder them together before installation. The coils may be mounted one above the other with a bolt running through the centers. You can, however, mount them in any way that will best fit the space available.

Mounting the module should present no problem even though it has absolutely no provisions for mounting. A few rubber grommets glued to the bottom of the module and then glued to the minibox will hold nicely. Leads should be covered with "spaghetti" tubing and run through a rubber grommet placed in a hole in the box under the module.

"Sounds great," said the kid. "How do you operate it?"

"Listen to this." The Old Man picked up the headphones. He switched the filter to its *out* position. With only one filter in operation, a few signals sounded in the phones. . .still nothing like the bedlam really existing on the band.

"You have to zero in on the filter's resonant frequency," he explained. "Tune the receiver's main tuning or bfo tuning control to adjust the beat note to the proper frequency."

"Wow, that signal really popped up there." The kid moved in closer, taking hold of the receiver dial. He tuned back and forth. "The strength of this one station comes through at least ten times louder when you hit the resonant frequency."

"That's right. Now let's flip in that second tank." The switch clicked and only one signal remained beeping in the phones. Adjacent signals could no longer be heard at all.

"There's that ringing sound," said the kid. "Makes it a little hard to copy."

"When the Q of a circuit (its selectivity) gets very high, the circuit begins to resonate," the OM explained. "That's the ringing effect you hear. Still, though, it's a small enough price to pay for not having to contend with a pile of other signals."

"You know," the kid grinned hopefully, "you really ought to build one of these for me. It would be a real lifesaver on 40 meters."

"What?" the OM demanded. "Do you mean to tell me that after sitting here and listening to this whole monolog, you don't think you can build one yourself?"

"Well," replied the kid, "the way I see it, if I spent all the time it would take me to build a filter, I wouldn't have time to learn the code well enough to use it."

The kid ducked as a box of screws sailed past his head.

...K8TSQ

DUALS

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Electronics is filled with dual-role phenomena All you have to do is look. . .

The electrical art in general has one very helpful feature, though this is little realized or appreciated, and that is the dual or reversible nature of many of its instruments. In mechanics, a steam engine may be driven by another engine and make a pretty good compressor. Mechanics has few of these cases, however, while electronics has several. This by no means doubles the student's knowledge without effort on his part, but it really does help. After all, if you knew one half of a Siamese twin to speak to, you could hardly avoid knowing the other half too.

Suppose you bought a new-fangled fringe-area TV antenna – which way would you point it? The way everyone else points his, of course. But the new one is different from theirs – which is the front and which is the back on the doggone thing? I couldn't tell you without seeing it, and maybe not even then. But let's examine highly directional antennas a moment:

One of the most directional, and highest gain antennas is the parabolic reflector type. These can have gains of around 40 dB (depending on frequency, size), which means that they transmit and receive 10,000 times the signal that a nondirective antenna would.

These antennas are usually called "bowls" and you often see them out in the country and on top of buildings. The bowl is actually a reflector, while the actual antenna is a little noodle of a thing in the former's focus. In Fig. 1, the transmitter T sends the signal to the antenna A, and the radio waves bounce off the bowl and are focused on the receiving bowl to the right, many miles away. Here the waves are focused on the receiving antenna A, run down the transmission line into the receiver R. Just look at a bowl and you can see without any difficulty which way it is aimed.

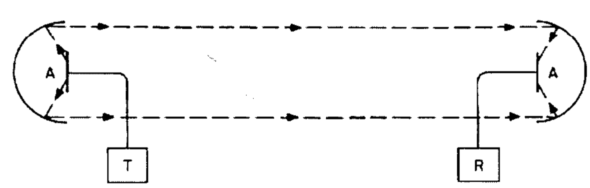

Fig. 1. The parabolic antenna concentrates virtually all the radiation into fairly tight beam.

Now consider the yagi antenna in Fig. 2. The longest element, or dipole, is at the left end and is called the reflector. The next element is the actual antenna, which is connected to the transmitter, or receiver, often switched back and forth alternately between them. In general, TV antennas are of this type. The arrow *usually* points in the direction in which the antenna transmits best – in the ideal case, toward the distant receiving antenna. At the same time, if it is used as a receiving antenna, the arrow points in the direction *from which* the best signal will arrive. You do not need to turn the antenna end-for-end when changing it from transmit to receive; this would be a clumsy expedient if it were necessary.

The same holds true for the rhombic and quad antennas in the same figure. In fact, it holds true for *any* directional antenna.

Now consider the vacuum tube; sometimes it has a simple function, as in a straight uncomplicated audio amplifier. But it is entirely capable of serving half a dozen functions at one and the same time. In a superheterodyne the same tube usually serves as a heterodyning oscillator and a frequency changing modulator at the same time. A simple regenerator, such as the type your grandpop used, is a regenerative detector and more often than not operated as a zero-beating oscillator at the same time – hence all the squealing you heard when they were tuned across a broadcast carrier. Not only that, but you could put an ordinary carbon microphone in the ground lead of one of these receivers and transmit your voice over it. This worked only for short distances, but it used the same tubes and antenna for both, and required no switching – it was completely automatic send and receive.

Or look at these toy-like walkie-talkies that children and fools abuse to the consternation of the FCC: They one and all rewire themselves at the touch of a thumbbutton so that the loudspeaker becomes the microphone, the first transistor becomes a transmitting element, and the audio amplifier is turned end-for-end. Dual? It surely is.

Years before the telephone was invented, kids used to play with string-and-can intercoms. They would punch a small hole in the bottom of an ordinary tin can – empty, of course–insert a string of thread and knot it, then stretch the string to a similar outfit in the next room or out in the yard. As long as the string was fairly taut and didn't rub on anything, it would

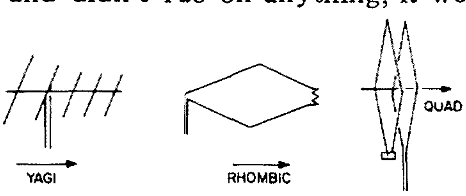

Fig. 2. Directional antennas must be pointed toward the station you're communicating with.

talk pretty good. This was acoustic duality; you had to holler into the can and poke one ear into it alternately. At the transmitting end, sound waves vibrated the string, and at the receiver, the string vibrated the diaphragm, which was the bottom of the can, making sound waves again.

To get back to aiming your TV antenna: One of the very best methods is to run a pair of wires up to your roof, with an ordinary head receiver, or pair of receivers at each end. No batteries, no amplifiers, just "Whoop and holler!" Actually, you don't have to talk all that loud; it works surprisingly well.

The theory is simple. The sound of your voice vibrates the diaphragm of the headphone (left unit in Fig. 3) which varies the air gap and consequently the magnetic flux in the headphone winding, which generates a current – you know, just like Lentz's law. Anyway, this current flows to the end of the wire and – Lentz's law again, backwards – vibrates the diaphragm and makes sound again.

Faraday himself knew that an electric current could produce motion through electromagnetism, and that the latter could generate a current by reverse action. When the electric motor was invented, it was realized at once that driving this motor with, say, a steam engine would generate current provided the field was magnetized, even slightly. A few years ago, when automobiles still had generators, the voltage regulator would occasionally fail and connect the generator directly across the battery which would instantly run the generator as a motor until the battery itself ran down. If the generator could not turn the engine over, this happened pretty quickly!

Of course, not all instruments are dual. While a telephone receiver, or loudspeaker, may transmit very clearly when sound strikes it, the current generated is weak. But send a current through a carbon microphone and the only sound you will get out of it is a sizzling, frying noise as it burns up, if you push it that far. But with normal current through it, it will transmit

Fig. 3. Sound-powered phones are an electrical equivalent of the once-popular string and can.

very well – more efficiently than any other type. It just isn't dual. Not all motors are, either.

Technicians have a little trick for finding hidden microphones. They induce a heavy signal into the general area by methods that are kept as secret as possible, and the microphones "squeal" like tiny loudspeakers. These are not magnetic types, but crystal microphones.

Another type of crystal is the quartz oscillating crystal. These are tiny squares cut from a quartz crystal, something like minuscule soda crackers in proportion. Now quartz is one of the most elastic substances extant (no kidding, it really is!) and these tiny squares will ring like a bell, except that you can't hear them, because the frequency is millions of vibrations per second. In fact, this is the actual physical vibration that keeps the broadcast transmitter exactly on frequency. It rings better – far better than a steel tuning fork, and is more stable. But more than that, it is self-exciting.

Marie Curie's husband Pierre discovered that if you strike certain crystals, they gave off electric shocks, and if you shocked them, they were distorted out of true. The distortion was infinitesmal, but the voltage generated was considerable. A quite recent ignition system for small engines squeezes a crystal to make the ignition spark – simple and reliable. To get back to the oscillating type, when the crystal oscillator was first tuned on, the voltage twisted the crystal a tiny amount, until it went as far as it would go. Then the crystal untwisted, generating a voltage of its own, which was amplified by tube or transistor and reapplied to the crystal which distorted again. This process is much like the operation of an ordinary doorbell, and results in a very pure vibration of the crystal, of very

precisely determined frequency, so long as the voltage is applied to the oscillator. But you need that twist-to-volts and volts-to-twist action to make the crystal oscillate in the first place. And these crystals have to be sliced and ground and etched from a piece of quartz crystal.

How about transformers? Take a filament transformer, for example: Put in 120V in the primary, and get 6.3V in the secondary. Or with 6.3V in the same winding, you will certainly get 120V in the other winding. The transformer doesn't know or care which way it steps, up or down, so long as you give it the right voltage and frequency. Pretty dual, I'd say.

A meter is a kind of dc motor. Will it generate electricity, too? Certainly! In fact, we can demonstrate this principle in a very useful test. Sometimes the meter is connected to the wrong points in a circuit and you wonder if it has been burned out. Or you see a nice microammeter in surplus, all dirty but apparently nearly new. Is it burned out? Or is it well worth the buck-fifty the man asks? You haven't any kind of test instrument to check it – all you have is your hands.

With the meter in your hand, see where the needle rests. (Fig. 4.) The zero adjustment may be a little off, but no matter. Suppose it is right on zero: now twist the meter to the left with a quick but not violent wrist-motion. The needle should swing 10 or 15 degrees upscale for a moment. This checks hair-spring and pivot, which must also be working okay. Now with a paper-clip, bit of wire, tie-clasp, or even a coin, short-circuit the terminals of the meter and try the twist again. This time, if the meter coil is all right, the needle should swing *much less* than before – perhaps only 5 degrees or so.

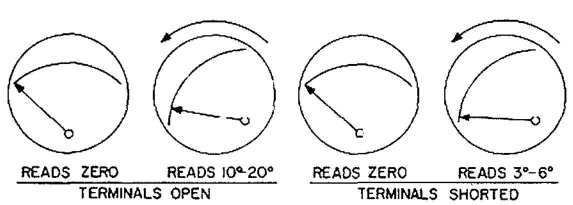

Fig. 4. A simple test can tell you a lot about a questionable meter.

When the meter terminals were open-circuited and the meter was twisted to make the needle swing, a voltage was generated by the coil moving in the magnetic field. But since no current could flow, no power was generated. But when the terminals were shorted, current *did* flow, power *was* generated, and dissipated in the winding itself, resisting the mechanical force that generated it by trying to drive the needle to the left. This is called "damping." Sensitive portable meters have a switch operated by the cover of the instrument, which shorts the meter coil when the cover is on. This prevents bending the needle due to carrying and shipping accidents, though if you drop it off a building you can kiss it goodbye.

Come to think of it, this duality business started before radio or wireless itself did. Maxwell deduced from the behavior of light that it was a kind of electromagnetic radiation, and that there should be others as yet undiscovered.

Hertz set out to find the undiscovered radiation. He used a spark coil of the same general type that Henry Ford used in his Model T ignition system. Connected to a battery, this gave a continuous series of sparks across a gap between two brass balls.

How to detect radiation from this? Sparks were disembodied electricity, so to speak; there was something magic about them. He took a brass rod about a yard long, put brass balls on the ends, and bent it into a circle or hoop, about a foot in diameter. If the gap between the balls was tiny enough, if the room was dark enough, if the loop was close enough, if the orientation was near enough, if anything like resonance was obtained, he should see a tiny spark in his loop. History tells us that he did, but you can't tell me this was accomplished all that easily. It probably took him quite a long time to try all the various positions and gaps and other variables until he hit on the one combination that would work. He had discovered hertzian waves, using a transmitter and receiver which were essentially duals of each other. More, he discovered hertzian waves with the most insensitive receiver ever built!

WB2PAP■

Clifford Klinert/WB6BIH
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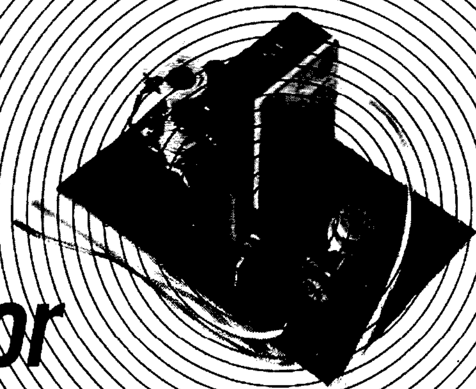
A MINIATURE Add-on Oscillator for 2m FM



In my past experiments with FM transmitters, I built up a simple crystal oscillator that is easy to reproduce and uses a minimum of components. The unit uses about 400 mW of power to an RCA 40080 NPN silicon transistor. This transistor is low in cost because of its wide usage commercially. This oscillator operates in the 6–8 MHz region with the tuned circuit described here, but should work well throughout the high-frequency spectrum.

This oscillator's first application was in an FM transmitter designed for 2 meters. The circuit layout as it is in this article was used as a crystal oscillator that was used to control the frequency of a receiver. When old AM receivers are used with VHF converters there is often a problem with frequency drift. The MARS or net operation is necessary, a drifting receiver can be a real headache. This oscillator can be built for only a few dollars, with a good junkbox. With a little study this oscillator can be used with almost any receiver to end the need for searching for the frequency each time and never being sure that no one is calling you. Of course, the oscillator can also be used as part of a transmitter, for a frequency spotter, crystal checker, an extra-frequency deck for an FM unit, or just an interesting little project to pass the afternoon.

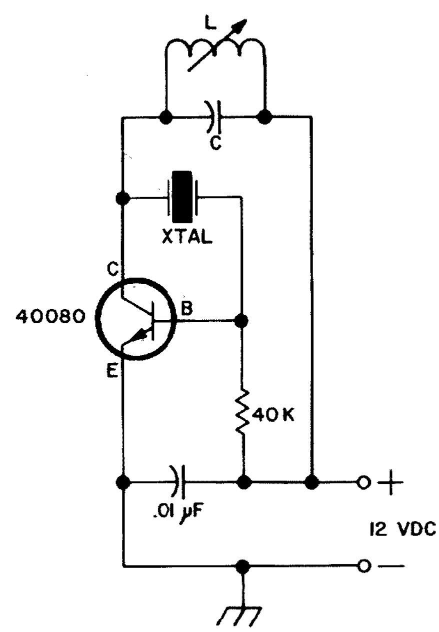


Fig. 1. Schematic diagram of simple oscillator.

Construction

The oscillator was built on a PC board and a layout is provided to simplify construction. The circuit is very noncritical, and can be wired up in almost any layout, but if you build a large number of projects and buy PC materials in large quantities, you will find that it is less expensive, much easier, and neater

than you think it might be. Ferric chloride is used for etching the copper and can be obtained from chemical supply houses in gallon sizes for that very purpose. PC board material can be obtained from electronics suppliers or by mail-order from dealers such as Allied in Chicago. The resist can be almost any kind of good enamel paint that is applied to the clean copper side of the board where the conductors are to remain. The board is then soaked in warm ferric chloride solution for ten minutes or so, until the desired action has taken place.

The board is cleaned, drilled, and the components soldered in place. The crystal socket used required slots instead of holes for mounting. The coil, mounted in a hole on one end of the board, is made from turns of 30-gage enamel wire on a ¼ in. diameter slug tuned form. The capacitor across the coil (C) is 275 pF, a dipped mica type. The tuned circuit should be approximately tuned to the desired frequency with a grid dip meter before applying it to the transistor. Any type of L or C can be used if it is tunable to the crystal frequency desired.

Operation

Plug a crystal into the socket after L and C have been determined with the grid dip meter. If a low-impedance power supply is to be used (batteries) a resistor should be placed in series with the power supply for safety reasons. The oscillator current will be 20–40 mA. If it is working properly, removing the crystal and tuning L and C will change the current. Tune for maximum output, not for maximum current. It will key better with a load attached. Because of the minimal circuitry, the oscillator tuning and operation may exhibit some strange characteristics, but it has never failed to give a strong clean signal. The output of the oscillator can be taken from the collector of the transistor with a small capacitor, or if more voltage is required, a secondary can be wound on L to provide higher output.

In the receiver used, power was easily taken from the cathode of the audio output tube. This will only work when a class A output stage is used. Since the tube itself limits the current obtained from the cathode bias, no resistor is needed to protect the transistor. The transistor runs slightly warm because of the power it is dissipating, and should not be placed in an extremely warm environment.

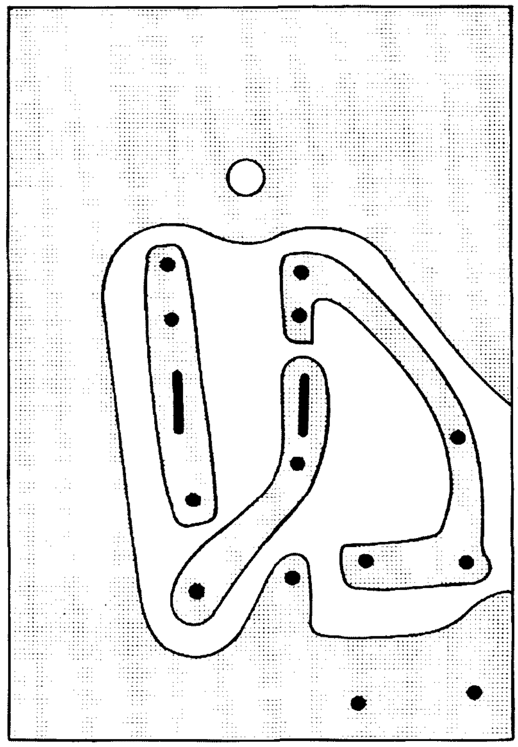


Fig. 2. 42% printed circuit layout; refer to the schematic and picture for parts placement.

The simple bias circuit used will not protect the transistor. A switch was wired into the receiver to short the grid of the receiver oscillator and turn on the crystal oscillator. The place and amount of oscillator injection must be determined by experiment. If not enough signal is available from the oscillator, it might be injected into the first rf stage of the receiver. This article assumes that the reader is familiar with how his own receiver operates, and will experiment to find best results.

Regardless of how this project is approached, it can fill a practical use or provide an afternoon's amusement at low cost.

The 40080 $1.30 is available from Circuit Specialists Co., Box 3047, Scottsdale AZ 85257. Add 15¢ for shipping.

. . .WB6BIH

GAIN ANTENNA for VHF/UHF REPEATERS

... Quadruples your repeater output power and will bring in solid those marginal mobiles in the fringe areas.

Ken W. Sessions, Jr. K6MVH

Probably the most popular antenna in the amateur repeater world is the omnidirectional collinear coaxial stack, although it is seldom called by that name. Versions of this antenna are manufactured by such companies as Prodelin, Phelps Dodge (Communications Products), and several other firms that build antennas specifically for the commercial bands.

Two of the reasons the collinear antenna is so popular are that it can be made to exhibit a great deal of omnidirectional gain at a very low angle of radiation and it takes up very little space. In its manufactured form, it resembles a long fishing pole with a pair of crossed fins at the base.

In spite of the fact that a great deal of painstaking effort is required to make the antenna and get it just right, the operation is surprisingly simple. And what makes it even more attractive to the amateur, it is remarkably inexpensive. About all you need is a good-sized hunk of 50Ω foam-dielectric coaxial cable and some polyvinyl-chloride (PVC) pipe. For 2 meters, the pipe should be between 20 and 21 ft in length; for 450 MHz, an 8 ft length will do fine. The total omnidirectional gain (as compared with a reference dipole) will be 6 dB (actually 5.8 dB, but who's counting?).

Building the Antenna

Ignoring the structural aspects, the antenna itself is nothing more than a series of precise lengths of coaxial cable soldered in an alternate phase-reversal configuration as shown in Fig. 1. A quarter-wave whip at the antenna's tip shorts the inner and outer conductors of the coax and becomes the terminal radiating element. At the lower end of the antenna, the last coax section

Invitation to transmit

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Calabasas CA 91302

I knew before we were married that he was a ham. He even told me. His mother used to give him books about electricity instead of letting him read comics.

I remember soon after we were married, he brought me a large paper bag. His eyes were shining, and he had the most lovable smile. I was ecstatic! He had actually gone out and bought something for our little home.

He did, but I actually didn't know quite what to say. In the bag was an aluminum box, with a few tubes and some wires.

"What is it"

"Two meters."

"Oh"

"A radio."

Suddenly, I had the overwhelming feeling that our marriage had just been invaded.

There was that one evening I sat in the livingroom alone, watching snow fall lightly outside, while he was up in the attic calling CQ, and thoroughly enjoying himself.

The time had come! I gathered all my courage, put on my winter jacket, and rehearsed my speech as I climbed those stairs. It was freezing up there! The air was drifting snow in one window and blowing dust out the other (through the cracks, of course).

It was very dark, except for the immediate area lit by the bulb dangling over his desk. He pointed to a box and motioned for me to sit down. He was holding the mike with his gloves on, and his breath fogged each time he spoke. I pulled up the wooden box close to the light bulb and sat.

When he finished talking to the other voice, I asked something that made me feel part of the action: "Why don't we set this up downstairs?"

He didn't think it was such a good idea. He didn't want to mess up the place with bits and pieces of solder. I nodded my head in agreement, since the place really wasn't ours to begin with. Well, I went downstairs, and began to read the Radio Amateur's Handbook. I figured I might as well start at the beginning of things to understand such an interest.

It has been three houses and six thousand miles later, and we still have all the stuff, and some new stuff; but at least the main antenna we have now doesn't oscillate when the wind blows, and it doesn't run down the middle of the house through the bedroom closet.

At present, we have a four-shelf bookcase pertaining to amateur radio and electronics.

Once in a great while, the pile of magazines for article cutting gets high, and he gets down on the floor with a pair of scissors and begins to leaf through all his books. It is amazing the effort and devotion one goes into.

"Hey, don't throw that out!" he shouts.

"Why not?"

"I haven't seen it."

"Woman's Day?"

"Oh."

If you are the wife of a ham, or the husband of one, don't despair. Amateur radio is a scientific hobby, and hobbies are a part of life just like golf, hunting, boating or cooking. A hobby is an interest to which one gives his spare time, that's all.

. . .Thurmond■

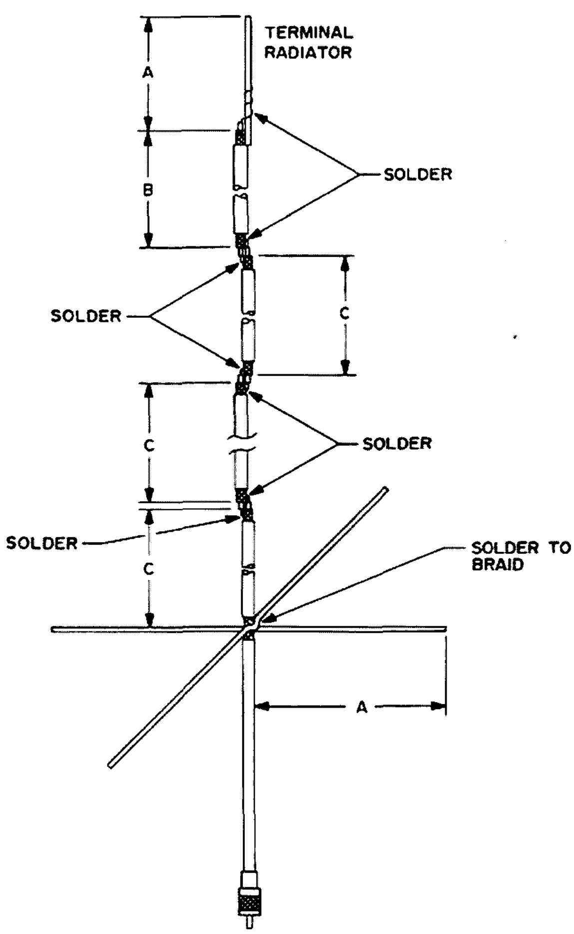

Fig. 1. The collinear gain antenna is made up of coaxial sections connected in a phase-reversal configuration. The bottom section (from the radials to the first joint) and the upper section (which joins the antenna to the shorted radiator) are half the size of all other sections.

actually becomes the feedline itself, whose length, incidentally, is not critical as long as the dimensions are followed with religious fanaticism.

A number of amateurs have managed to build antennas of this type, and diagrams have never been scarce. But few have handled the project successfully. Getting the antenna together is no big deal. The problems start to happen when it's time to turn the soldered-together pieces of coax into a structurally sound antenna. Applying wet epoxy, as in a fiber-glassing scheme, doesn't work out. I have yet to determine whether the problems are attributable to some chemical interaction between the wet epoxy and the coax dielectric (changing the dielectric constant of the line) or because the hardened epoxy doesn't allow any flexing of the coax braid. In any event, sealing the antenna with

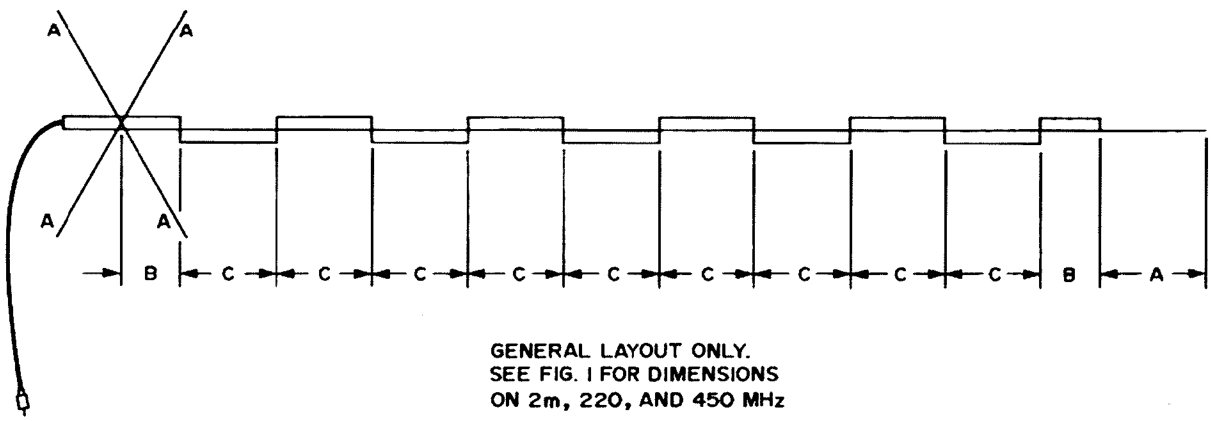

Fig. 2. Layout and dimensions of collinear gain antenna. The 2 meter dimensions are for a frequency of 147 MHz; the 450 MHz dimensions are for 442 MHz exactly. The 220 dimensions are for 220.5, just half the 450 frequency. The antenna is broadbanded enough to yield a low vswr on any frequency within a megahertz of that shown.

epoxy is ultrabad news. When the antenna is rigid and looks great, you'll measure a very disappointingly high standing wave ratio and you'll discover with much lament that your old groundplane worked better.

The commercial antenna people use fiber glass, but they do not use it to seal the antenna. Instead, they use an inert and flexible sealer, then encase the whole business within a preformed fiber-glass tubular envelope. At least one of the commercial suppliers uses beeswax as the inert sealer. Actually, there is no real need to immobilize the antenna once it has been placed inside the PVC pipe. The most important point in the construction process is to make the thing water-tight. Water drops inside a hunk of coax do bad things to antennas and feedlines; and once the water gets inside, you're better off changing antennas than trying to ignore the problems.

The dimensional details of the antenna are shown in Fig. 2. Lengths have been calculated in the decimal system to the nearest hundredth of an inch. Of course, you'll not be able to maintain this accuracy, but the system did simplify the computations. The 2 meter figures are based on an operating frequency of 147 MHz. The antenna is broadbanded enough to give an swr of close to unity regardless of the FM channel of operation. The 450 MHz frequency of operation is 441 MHz,

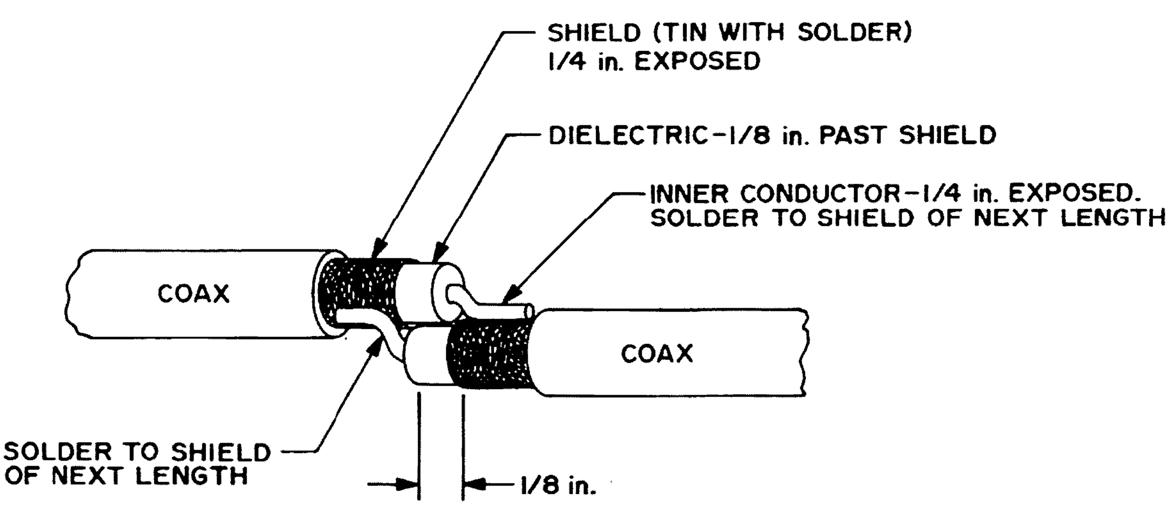

Fig. 3. The coaxial lengths should be soldered as shown. Keep the braid trimmed evenly all the way around and make sure the braid from one section doesn't make contact with the braid of the next section. If conductors are well tinned, problems will be minimized. Coax lengths are measured individually from braid end to braid end.

exactly three times the frequency of the 2 meter version. You'll note that the 450 dimensions are just one-third those shown for the 2 meter version. If you build both antennas, don't select those two exact frequencies for repeater channels or you'll likely end up with your 2 meter system triggering your 450 receiver – it *has* happened. The 220 dimensions are calculated for 220.5 MHz (half the 450 frequency). I haven't built the antenna for 220 because I've never had the occasion to use that band except when getting into W6ZJU's private repeater. But if 450 continues its trend of increasing population, there should be a general turning to 220 MHz for repeater control in the not-too-distant offing.

To begin construction, cut eight lengths of coax from the reel. Each piece should be cut about an inch oversize, then trimmed down later so that all pieces are of exactly the same length. The dimensions given are end-of-braid to end-of-braid for any given length. (See closeup detail in Fig. 3.) The braid-to-braid distance should be approximately the same as the distance between the inner and the outer conductor of the coax you're using, or approximately 1/8 in. This dimension is the only one that does not change with operating frequency or band.

When all the lengths have been cut and trimmed to the precise lengths, and you are sure they will fit together as shown, study Fig. 3 carefully, then tin all exposed braid and conductors. This tinning process is an important step and should be done as completely as you can manage it.

As you solder the lengths together, use care to avoid handling the soldered pieces any more than is absolutely necessary. The braid can pull loose without much encouragement – and when that happens your only recourse is to replace the section with the loose braid. Winding each joint with electrical tape has always worked out well for me, but I always wonder if everything is okay under that tape. Once the tape is applied, you'll just have to guess about the condition of the hidden joint. The best approach would probably be to make all joints first, then inspect the whole antenna. If everything looks shipshape, then go ahead and wrap the joints with tape. Just be very careful in the handling until the antenna is safely stuffed into its plastic pipe.

The quarter-wave radiator that goes at the top can be any good conductor, but copper is best. And the easiest way to get a good, stiff copper conductor is to buy some narrow-diameter (1/8 in. is ideal) copper tubing. The same material can be used for the radials at the base of the antenna. I *have* used type TW soft-drawn copper wire (10-gage), but it has proved too flexible for applications involving remote mounting – such as at distant repeater sites. The tubing offers a great deal better stability. If you have a heavy-wattage soldering iron or gun, you'll have excellent results soldering the tubing, too – even though you'll probably have to file or scrape the parts where solder is to be applied.

Ground Radials

There is nothing sacred about the manner in which the radials are attached to the antenna. Figure 4 shows the system I used, which worked but had a rather ugh look about it. K6VBT built one and used an arrangement of his own that looked

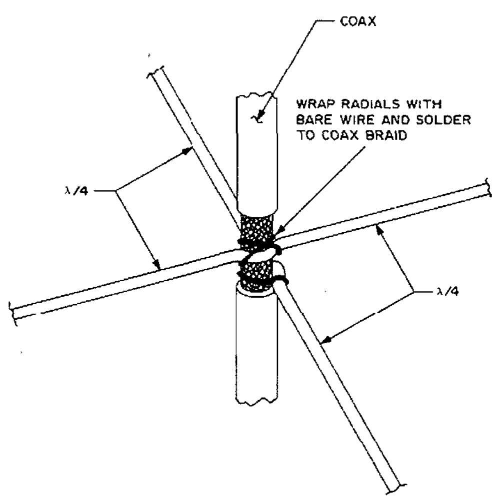

Fig. 4. Radials, of narrow-diameter copper tubing, should be cut to slightly longer than a half wavelength. The center should be bent to conform to the rounded shape of the coax braid so that on each radial a quarter-wave length extends outward from the coaxial braid. Tin the braid first. After wire-wrapping and soldering, wrap the joint well with electrical tape.

much more professional – but his required a lot more work and some rather precision drill work in the PVC pipe. The idea is to get four 19 in. radials extending equilaterally away from the antenna while maintaining some structural integrity. If the concept of Fig. 4 is adopted, the slot arrangement of Fig. 5 will hold things together satisfactorily.

The slots (Fig. 5) are cut lengthwise into the bottom of the PVC pipe so that the radials can be held in place when the PVC is inserted into the mounting pipe (made of heavy metal). The metal pipe is notched gently to seat the radials. Before inserting the PVC into the larger pipe, the slots on the PVC should be taped up (after the antenna is installed in the PVC sheath, of course).

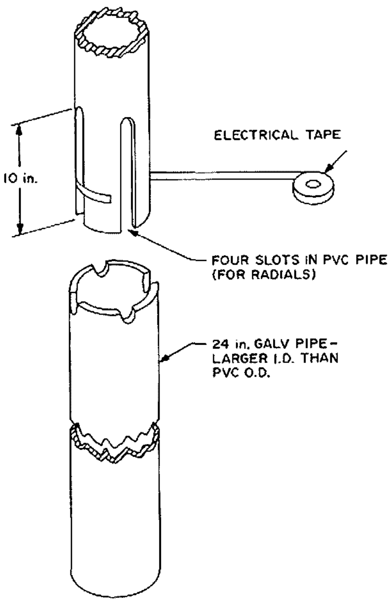

Fig. 5. Long slots in the PVC pipe will hold the radials in place with the antenna inserted. Wrap the bottom well with electrical tape after the antenna is installed in the fiber tube. Notch four matching places on a 2 ft length of galvanized pipe to seat, and try for a snug fit.

Building your own gain antenna *is* a lot of trouble, as you can readily see. But it looks pretty attractive when you start pricing the commercial equivalents. And there is an almost indescribable satisfaction that comes with putting out a good "commercial quality" signal from a homebrew antenna.

One Last Note

If your repeater doesn't give omnidirectional coverage, or if you'd rather have a definite preplanned radiation pattern, you can get considerably more gain than the 5.8 dB already promised by merely spacing the antenna a prescribed number of quarter wavelengths from the tower. Of course this means that your antenna will have to be side-mounted rather than top-mounted. If you space the antenna one quarter-wave from the tower, you'll get a major lobe in the same direction as the antenna is from the tower mass, as shown in Fig. 6A. Each additional quarter-wave essentially adds a lobe that exceeds the 5.8 dB omnidirectional reference point.

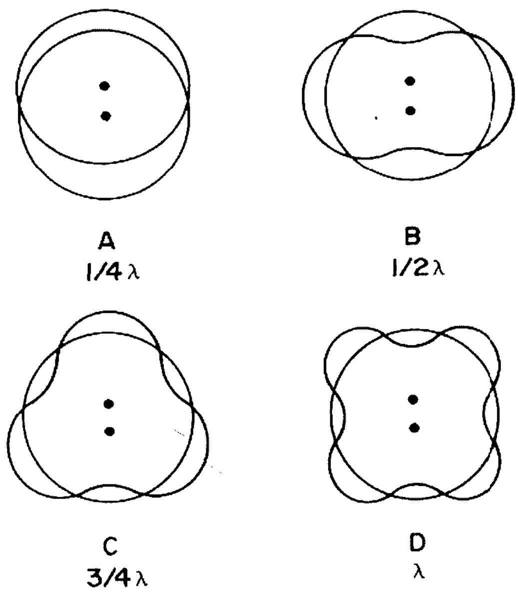

Fig. 6. By spacing the antenna the proper number of quarter wavelenghs, some interesting radiation patterns can be obtained. In the patterns shown, the circles represent the 5.8 dB omnidirectional gain achieved by top-mounting. The asymmetrical overlays represent the patterns obtained by side-mounting. Note that even though signal loss occurs in some directions, significant gain improvement is realized in other areas.

Playing around with antenna-to-tower spacing can help you spend a jolly afternoon at your repeater site – which can be great fun when compared with painting the fence or fixing the wife's vacuum cleaner. So grab yourself a hunk of coax or two and get started on the antenna. Then take a good look at a map of your area and see if you can't improve your repeater's efficiency by some selective mounting techniques.

. . .K6MVH■

DESKTOP BASE STATION from MOTOROLA G STRIPS

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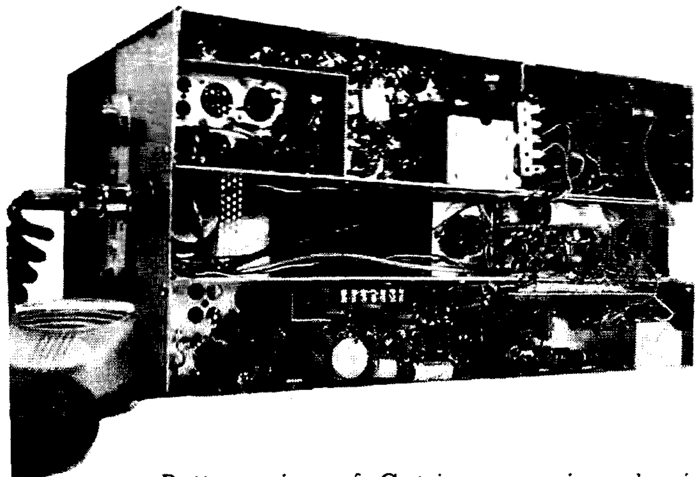
Milwaukee WI 53211



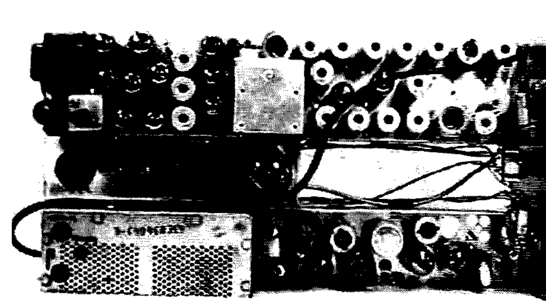
Bottom view of G-stripper, receiver chassis at the top, conversion chassis in the middle, transmitter chassis at the bottom. Note the compactness of the unit; it makes a neat 15 x 7¾ x 5¼ in. station.

There have been a large number of manufacturers making equipment for the 2 meter FM enthusiast; but a lot of interest has also been generated on 6 meters and 10 meters. Yet, there is no newly manufactured equipment specifically designed for these frequencies. The only logical route for amateur radio operators is commercial surplus low-band equipment. (Low-band FM gear generally covers 25–50 MHz.)

After having tried several different types of equipment and methods of conversion, I will report to you my results with constructing 6- and 10-meter base stations. My concern for this equipment was compact size so that it would be compatible with my present SSB exciter and would fit comfortably on my desk. And the equipment had to be attractive enough so tha' my wife wouldn't try to get rid of it every time I left the house.

Receiver sensitivity and transmitter output should be compatible with present-day standards. The units should be flexible enough in design to allow multi-frequency operation, remote control, and tone operation. Finally, it must be inexpensive.

How was this vast list of specifications finally filled? With "G" strips – those compact units which made possible such units as Motorola's T41GGV or U51GGT. These units are only 15 in. long and around 3 in. wide. They have become available separately, as strips rather than mobile units, through Mann Communications* at a combined price of $28. Considering that surplus base stations using these strips are not available for less than $150, this seems to make these strips a good deal for the amateur with a little time and an old TV power transformer for an ac power supply.



Top view of G–stripper; receiver chassis is at the top. Note the placement of components on the conversion chassis– from left to right, octal pov'er plug, speaker jack, and voltage regulator for the transmitter oscillator.

*Mann Communications, 18669 Ventura Blvd., Tarzana CA 91356.

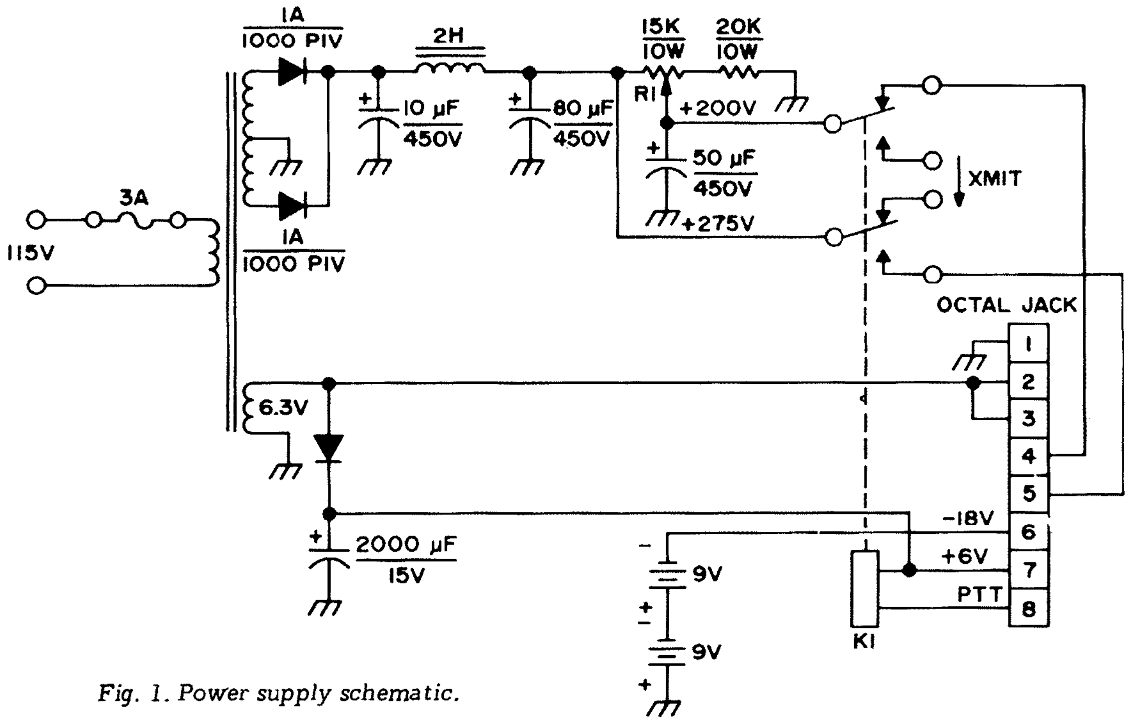


Fig. 1. Power supply schematic.

The power supply (Fig. 1) can be constructed on a separate 2½ x 5 x 13 in. aluminum chassis so it can be placed remotely. This helps keep the desktop package compact and eliminates a lot of unnecessary heat in the transceiver cabinet. The power supply contains the TV power transformer, high-voltage rectifying and filtering components, bias supply, filament supply, transmit-receive relay, and control voltages. Layout of this chassis is not difficult; work for best mechanical design and easy wiring.

The conversion chassis (Fig. 2) is placed between the receiver and transmitter. It replaces the old mobile power supply. This chassis contains tie points for connecting various receiver and transmitter functions, a standard phone jack for the speaker, voltage regulator tube, octal power plug, and accompanying components. Four groups of 6-32 hardware

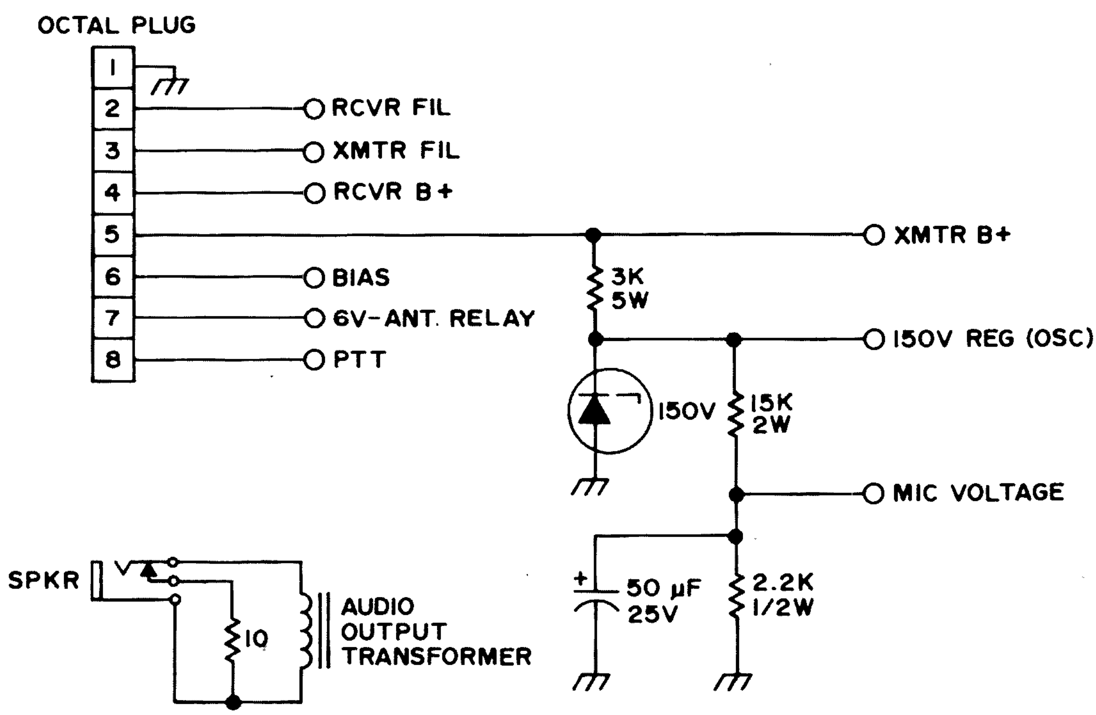
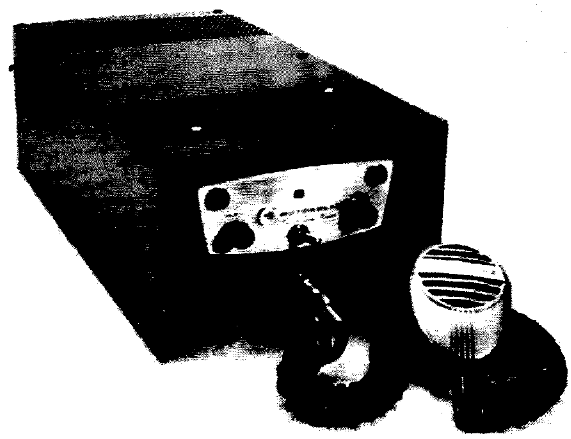


Fig. 2. Conversion chassis schematic

are used to hold the three chassis together. The conversion chassis was made of scrap aluminum about 1/16 in. thick. The mechanical layout for this chassis is shown in Fig. 3.

The front panel is also constructed from scrap aluminum. The front panel layout is shown in Fig. 4. An escutcheon from a Motorola control head will dress up the unit considerably and the components from the control head can be used in the front panel. The front panel is easily mounted because the fronts of the strips are drilled and tapped for 6-32 hardware. Four 6-32 binder head screws will securely attach the front panel to both the transmitter and receiver strips also adding a great deal of mechanical stability. The schematic for the panel elements is shown in Fig. 5.



Simple U-shaped cabinet is made of scrap aluminum. The speaker is mounted behind the perforated part of the cabinet at the top front of the cabinet. Choose your own color combinations, and refinish mike to match unit.

Electrical Considerations

Fortunately, schematic diagrams are easily available for these units. The *FM Schematic Digest** not only contains the schematics for this equipment, but other helpful information for servicing, alignment, and ordering the proper crystals.

The power supply is built around an old TV power transformer which has been a fine choice in that the price is right and the power supply is very flexible. I have built three of these units and have used a different transformer each time with excellent results. In reference to Fig. 1, note that R1 can be adjusted to deliver 200V under load to the receiver.

The conversion chassis is primarily needed because when these strips were in their original mobile unit, the receiver and transmitter were not connected by plugs, but were wired together in manufacture. The conversion chassis serves as a place to connect the cut ends of the strips and a

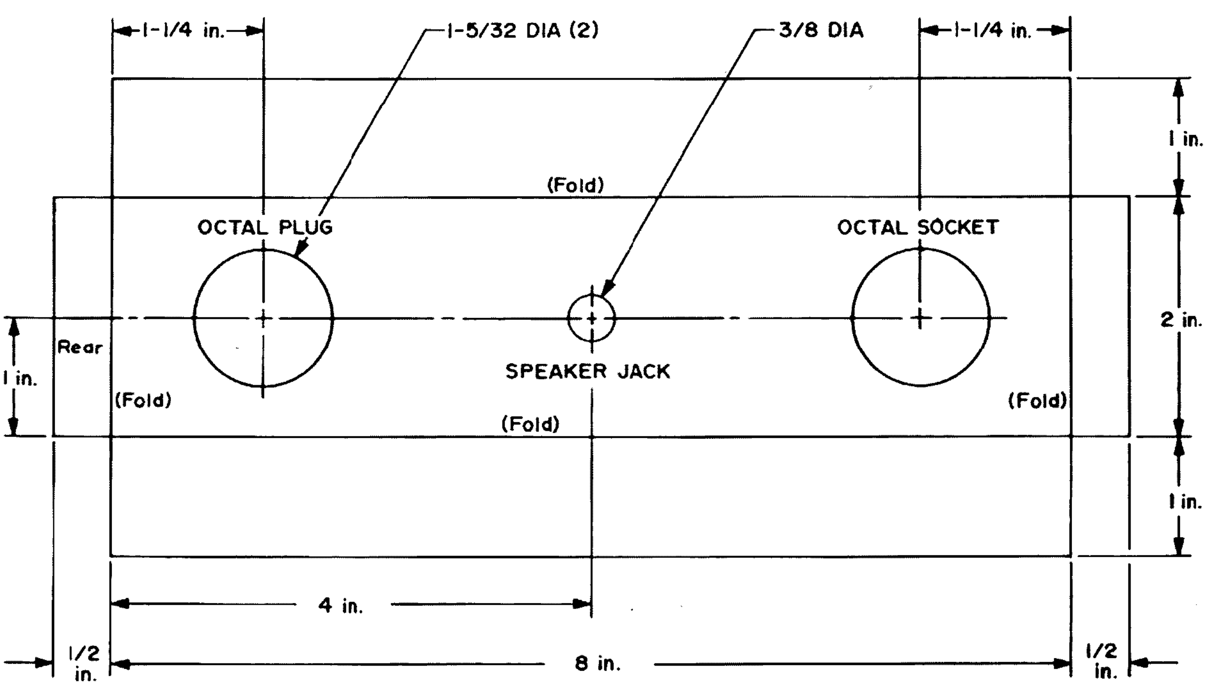
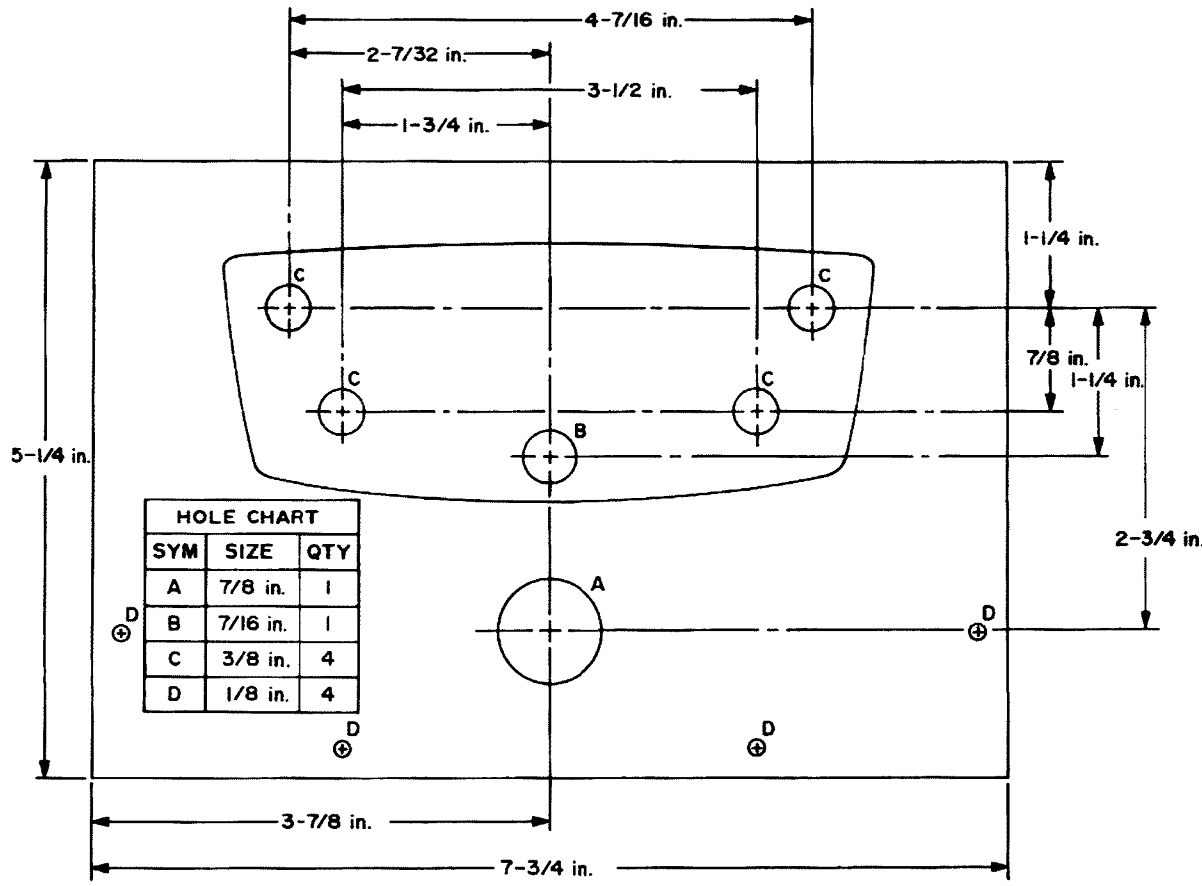


Fig. 3. Conversion chassis flat pattern layout.

*Sherman Wolf, Two-Way Radio Engineers, 1100 Tremont St., Boston MA 02120.



HOLE CHART		
SYM	SIZE	QTY
A	7/8 in.	1
B	7/16 in.	1
C	3/8 in.	4
D	1/8 in.	4

NOTE: POSITION OF "D" HOLES MAY VARY WITH DIFFERENT STRIPS.

Fig. 4. Front panel layout.

place for the power plug and speaker jack. The screen and plate of the final amplifier are tied together in this conversion. This produces an output of about 15W depending upon the age and condition of the tubes in the transmitter. By modifying the power supply to a bridge rectifier, outputs of 50 and 60W are possible. There is enough room in the conversion chassis for the additional wiring needed if two-frequency operation is required or a tone system is to be used. The conversion chassis may also be lengthened to accommodate accessories like a mike preamplifier or carrier-operated relay.

The cabinet is a simple U-shaped piece of aluminum covering the unit. The cabinet was extended a bit beyond the front panel to improve its appearance. I made the cabinet out of three pieces of aluminum bolted together. I used solid pieces for the sides and a perforated piece for the top.

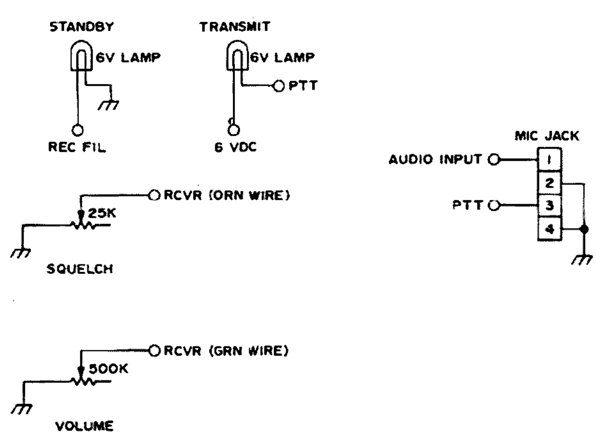


Fig. 5. Front panel schematic.

Miscellany

Table I indicates the wire color code for the cut receiver and transmitter connections. Table II gives the pin functions that I used on my octal power cable. If there is a heavy enough wire, the receiver and transmitter filament leads can be tied together. This will give you an extra connection for an additional function. An 11-pin socket can be used for more

flexibility and control of power functions.

Table I - Lead Identification Connections

Function	Color Code
6.3V ac Filament	Brown
Rcvr fil return-ground	Green with yellow stripe
Rcvr + 200V	Red
Rcvr audio control	Green
Squelch control	Orange
Xmtr audio and shield	Green shielded cable
Mike dc	Green with white stripe
Xmtr 150V dc	Red with black stripe
Xmtr 275V dc	Red with yellow stripe
PA screen	Orange
PA plate	Red with blue stripe
Bias	Green with red stripe
Xmtr fil return-ground	Brown with yellow stripe

Table II - Power Cord Connections

Pin Number	Function
1	Common-Chassis ground
2	Receiver Filament
3	Transmitter Filament
4	Receiver B+
5	Transmitter B+
6	Bias
7	6 or 12V dc
8	Control-push to talk

Some of the strips I have worked with have a disease called "hardening of the insulation." In case this should cause you any problems, it will be helpful to replace the wiring from the transmitter and receiver tie strips to their respective tie points in the conversion chassis. Carefully check wires in the strips that run tight against the chassis for shorts. . . .W9VZR■

Jack Taylor W4CWB
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Arlington VA

CAMOUFLAGE EXTRACLASS

This article is dedicated to K9AZG* and all hams who desire to improve the state of the art but must cope with XYL-itis in erecting beam antennas. The plans that follow are foolproof and allow you to assume control. However, the author assumes no responsibility for their success because his XYL won't let him.

Plan I.

Jack threw the big switch. Between the QRN from an impending storm and the impotent signal generated by his attic antenna it had been a most frustrating evening.

"I just can't get out," he mused.

The lone QSL card from W2NSD/1, obtained "eyeball" at the '58 ARRL Convention, some samples from printers, and an SWL card from a boy scout on the next block bore mute testimony of the fact.

"Damned females and their sense of esthetics, if only I could put up a beam," and as an afterthought, "and still keep peace with the XYL."

A rumble of distant thunder heralded the arrival of the storm. Quickly he made a phone call, yawned most audibly and to the XYL upstairs he called, "Nancy, let's turn in, I'm bushed."

The storm broke – successive flashes of light penetrated the shuttered darkness of the bedroom. Each flash being followed by a sharp clap of thunder that rattled and reverberated throughout the house.

"A thousand and one, a thousand and . . . "

"Jack, stop that," cried Nancy, "I'm scared enough as it is." "Did you turn off that dumb radio?" "Yeah, yeah," responded Jack, giving her a reassuring hug, "now try to get some sleep."

Jack awoke the next morning to streamers of sunlight stealing through the blinds, the aroma of breakfast coffee and a loud resounding knock on the front door. Nancy answered it. A man with a charred brick in his outstretched hand framed the entrance way.

*See article by K9AZG entitled "Camouflage" October 1970 issue of 73

"Good morning, m'am, some storm we had last night," he said in way of introduction. "I've been surveying the neighborhood for storm damage – it's my business, you know – lightning protection. You folks had a narrow escape, only lost a brick from your chimney – lucky! Could have been worse."

Jack had heard enough. He stormed toward the door shouting, "I don't believe it – I've heard about you fellows faking damage." He turned to Nancy and said, "I'm going up on the roof and see if a brick really is missing. However, when I get down, I suspect our caller will be the only thing missing."

Nancy appeared embarrassed. The caller appeared hurt but replied, "I'll wait." Ten minutes later a somber Jack faced Nancy.

"The man's right, Honey, a brick is missing!"

To the man: "Come in, Sir, and tell us what we need in the way of lightning protection!"

The man stayed about fifteen minutes – time for his sales pitch, a signed contract and a cup of coffee. After he had gone, they both sighed in nervous relief.

"To think," said Nancy, "we almost lost our house to lightning, when full protection can be had by a decorative flagpole lightning arrestor in the back yard!"

"I feel guilty too, Honey," said Jack, "now that I know my attic antenna contributed to the danger – I'll take it down." He lowered his head. The XYL was responsive, "Don't feel badly, Dear, remember the man said you could put an antenna on the flagpole and it would even increase our protection," she paused – "if you don't mind."

Some weeks later Jack was in QSO:

"K4SGO, this is W4CWB, how copy Marv?"

"W4CWB, this is K4SGO, Q5 S9+20, but cheapskate, when are you going to return the brick I used from my patio fireplace?"

Plan II

Plan II is tailored for a certain breed of impatient hams that will rush to the corner drug store to buy a tube on Sunday night rather than honorably scrounging same, or who can't wait for the proper climatic conditions to execute plan I. Fortunately, this plan is also foolproof and the XYL can be conned as easily as with the flagpole routine.

Seriously, have you ever seen an XYL that wouldn't like to have a better picture on the "boob tube." Of course you haven't!

And what is the average TV antenna installation? One driven element, fed with cheap 2¢-a-foot transmission line (and one parasitic element). Point out its ugly appearance on the roof! Exercise pride.

Take down this eyesore. Restore the graceful and clean architecture of your home. In extreme cases you can even cut the grass to impress on the XYL your sincerity for the "house beautiful."

Now that this blemish has been removed, buy the largest TV antenna you can find. Some of them are really massive. Be sure to assemble it in the living room, where it must remain (under any pretext) for at least 24 hours. This is important because you are psychologically conditioning the XYL to size. Be sure that the carton identifying the monstrosity as a TV antenna remains there, too.

Next, install the antenna on a tower that will later also support your beam. Be sure to mount the TV antenna at suitable height for good reception (but reserve the top spot for you-know-what!); then feed the antenna with high grade transmission line. The XYL will be both amazed and proud of her improved TV picture. Your image will improve too. She may even tell her mother that maybe her marriage wasn't a mistake after all.

Now for the ultimate camouflage! On the chosen day encourage the XYL to go on a little shopping spree. Now do your thing! Upon her return she will voice little or no opposition to your beam which incidentally will appear smaller (than hers) on top of the tower!

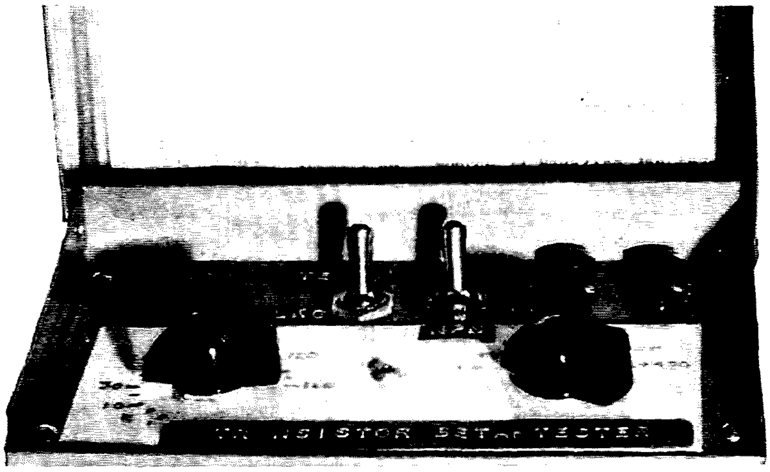
Plan III

Truly, this is for desperate cases, so upon request we will mail in plain brown wrapper . . . ...W4CWB■

FILE BOX

Samuel C. Milbourne WB4ITN
4624 Daugette Drive N.W.
Huntsville AL 33805

Transistor Beta Tester



Previous articles described two test units in a line of "file box" test equipment, so called because they all are housed in metal file boxes sold to hold 4 x 6 in. file cards.

This month, we have a convenient *transistor beta tester*. As Thorp[1] describes it, the main tests required to determine the adequacy of a transistor are:

1. Determine if NPN or PNP type.
2. Check for short between collector and emitter, collector and base, or base and emitter.
3. Look for open collector, base, or emitter.
4. Check the relative leakage of the transistor.
5. Determine the transistor beta (current gain).
6. Monitor the relative noise level by ear.

Previous design allowed testing of beta to 150. However, higher scale readings were noted and a range switch of plus 100, 200, 300, and 400 was added. By using this equation a fairly accurate tester will result (Fig. 1).

$$\beta = \frac{R4}{2 \times R5}$$

$$R4 = 150\ k\Omega$$

$$R5 = 500\ \Omega$$

Let us assume that we will vary R4 until the dc voltage V_e equals 2V. The resulting resistance of R4 when divided by 1 kΩ (2 x R5) will result in the transistor current gain (in kilohms).

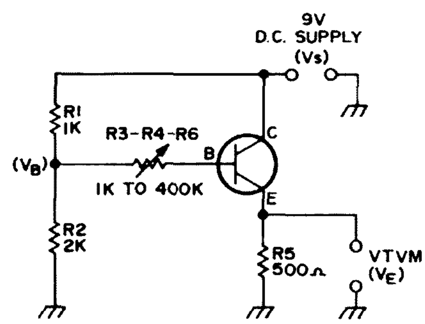


Fig. 1. Simplified Beta Test Circuit

For example, after setting V_e at 2V for a specific transistor, by adjusting R4, you may have a total of 130 kΩ across R4. This is the direct equivalent of a beta of 130. You will be surprised how much several transistors of the same type will vary in beta. Now, you can determine which are the "hot" ones in a handful of transistors, all of the same type.

Look at **Fig. 1** again. This is a simplified circuit. It is a common-emitter type. The two resistors (R1 and R2) form a voltage divider across the 9V power supply. The point V_b will measure 6V to ground. Thus, with the variable resistance set at minimum, the transistor base-to-ground voltage will be 6V. There will be a drop of 0.3V (germanium) to 0.7V (silicon) across from base to emitter of the transistor. The remainder of the 6V will appear across

[1]**Thorpe, Darrel,** *73*, **Jan. 1967, p. 38.**

emitter resistor R5 (approximately 5.5V). By adding the 5.5 and 0.5V we get 6V, or 3V from base to collector.

If we change the variable resistor, we can change the ratio of resistance between the base and emitter resistors. By arbitrarily pegging R5 at 500Ω the beta will conform to the formula above. In practice, the variable resistor will be calibrated, with an accurate ohmmeter, to show beta.

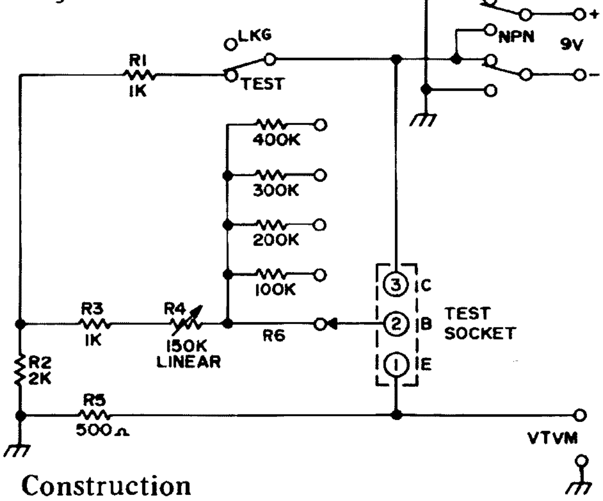
Figure 2 shows the actual transistor beta tester. You will see that either a collector-to-base, or a collector-to-emitter short will show a full power supply (9V) reading.

A base-to-emitter short will read 2V if the variable resistor is at minimum. Under this condition, R1 and R5 will then be a voltage divider across 6V, with 4V across R1 and 2V across R5. An open collector will produce the same reading. If either the base or the emitter is open, no voltage will result across R5.

A leakage test is performed by opening the supply voltage at R1. There will always be a small leakage which will result in no reading or a small reading. The lower the leakage, the lower the reading.

Whether the transistor under test is a PNP or an NPN type is easily determined by throwing the toggle switch to the position which results in a forward reading of the VTVM.

Fig. 2. Transistor Beta Tester



Construction

The first thing to do is to collect the necessary parts, as follows:

File box:

(1) File Box 4 x 6 x 4 1/2 in. Ohio Art Co. or equivalent.

(2) pcs. 1/2 x 1/2 x 1/16 x 4 in. of aluminum angle bracket. (Reynolds Aluminum #2406, old number #161, or equivalent.)

(4) Rubber feet with 6-32 mounting screws and nuts.

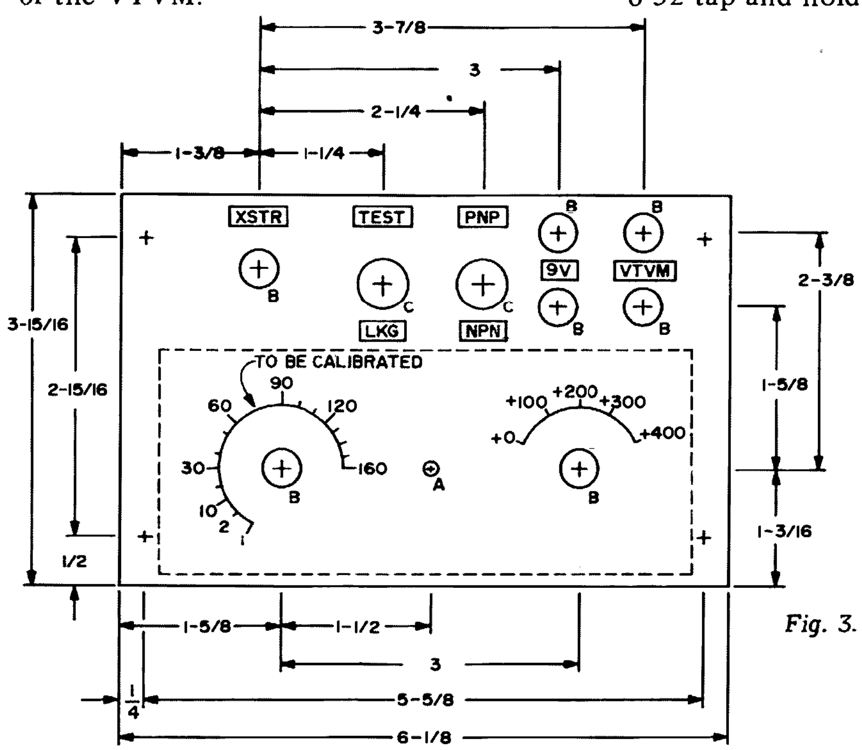
(1) Panel, aluminum, 6 1/8 x 3 15/16 x .030 in.

(8) Machine screws 6-32 x 1/4 in.

Miscellaneous tools and materials:

Twist drills (#25 and #35).

6-32 tap and holder.



HOLE CHART		
LTR	SIZE	QTY
A	NO. 25	1
B	3/8	8
C	1/2	2

Fig. 3. Front panel dimensions and markings.

Fine steel wool.
Alcohol (for panel cleaning, not internal comfort).
Zinc-chromate spray
Lacquer spray, RCA 222627
Tape embosser and tape.

Transistor Beta Tester:

(1) Switch, 1 Pole, 5 position
(1) Potentiometer, 150 kΩ
(2) Knobs
(1) Switch, spdt
(1) Switch,dpdt
(2) Resistors, 1 kΩ
(1 each) Resistors, 500Ω, 2 kΩ, 100 kΩ, 200 kΩ, 300 kΩ, and 400 kΩ
(1) Socket, transistor
(1) Banana jack, red, with panel insulator
(3) Banana jack, black, with panel insulator
(1) Standoff, insulated lug

Assemble the file box by mounting feet 1/2 in. in from each corner. Mount the angles inside the box. Position them just below the top edge of the box and at each end. Detailed instructions on this and other construction can be obtained from the previous articles. The holes for the screws in the sides are 2 in. apart and centered. The tapped screw holes for the panel are positioned 3 in. apart and centered. The holes in the side are made with a #25 drill. Those in the bracket tops are made with a #35 drill and then tapped using a 6-32 tap. The panel is laid out and drilled or punched as shown in Fig. 3. Note that the 9V battery is shown as external to the unit. It can be mounted internally, but unless test units are to be used regularly, it is better to keep the battery external. You may also note that the picture showing the finished unit does not indicate the use of a transistor socket. The original idea was to provide several sockets in another case, but this proved cumbersome.

Before drilling or punching, always check your own parts to see that the required holes agree with those given here.

After drilling the panel, prepare it for painting and spray it as recommended in previous articles. Prepare the tapes as indicated by the picture and Fig. 3, and affix them as shown in Fig. 3. Take an index card cut to 2 3/8 x 4 1/4 in. and layout as

shown in Fig. 3. Use india ink or press-on numbers. The left-hand control will have to be calibrated by placing the card on the panel, attaching the pot and knob, and then, with an ohmmeter, mark out the kilohms.

Mount all the parts on the panel, including the insulated lug. Wire the unit, swinging the resistors between points as required. Before the tester is finalized, the white card on the panel may be sprayed with clear acrylic. Draw up the schematic and mount it under the unit on the box bottom. Use tape with adhesive on both sides or glue.

Finally, type or cut out the following and paste onto a 4 x 6 card and install it in the file-box top.

QUALITY

1. Set PNP-NPN switch to proper position.
2. Set *BETA* controls to zero.
3. Set *LKG-TEST* switch to TEST
4. Approx. VTVM Readings:

Good	5.5 v.
C-E Short	9.0 v
C-B Short	9.0 v.
B-E Short	2.0 v.
C Open	2.0 v.
B Open	0 v.
E Open	0 v.

BETA

1. Adjust *BETA* controls to a VTVM reading of 2.0 v.
2. Read beta directly by adding calibrated and switch control reading.

LEAKAGE

1. Reset *BETA* controls to zero.
2. Set *LKG-TEST* switch to *LKG.*
3. Observe VTVM reading.

NOISE CHECK

1. Connect headphones in place of VTVM.
2. Monitor noise level by ear.

$$\text{Beta} = \frac{R4}{2 \times R5} = \frac{R4}{2 \times 500} = R4 \text{ in Kilohms}$$

. . .WB4ITN■

Mark Hurwich WA2ITE
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Call Sign Plaque

During my own rather short amateur career, I have met very few other hams who were not proud of being a radio amateur. To show the world their hard won prize, many invest a fair amount of money in some device which displays their call sign. Call sign plaques can often be expensive, but they need not be. You can make your own with very little effort and for a cost of only $2.50 (or even less).

To start, I purchased six "house letters" (the letters printed on a gold-anodized aluminum sheet, with an adhesive backing). These were 25¢ each, for the largest size (3½ in. high). A piece of ¼ in. plywood with a walnut veneer was obtained from the local lumber yard for 75¢, about 6 in. wide and 2 ft long. To leave a 1¾ in. border, slightly longer on the ends, it was then cut to 20 in. The corners were rounded, edges sanded, and finally the face was *gently* sanded (use fine paper – the veneer's only 1/32 in. thick!).

I chose to finish the surface "antique oil" (wax or shellac could do just as fine). The surface is waxed, shined, and then left to harden. A finish such as *Minwax Antique Oil Finish* is then applied over the wax, to be wiped off two hours later and buffed. This results in a beautiful soft finish, which completely dries in 24 hours.

The edges are next dyed the color of the veneer using (brown) shoe polish. The last step is merely to draw a centering line and mount the letters.

By the way, the same finish on a "hunk" of walnut makes a fantastic key base!

. . .WA2ITE■

ZERO BEAT

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Temple Terrace FL 33617

Anyone who has ever operated in a net has complained about other stations being off frequency. Crystal control by itself does not help, both because of fine differences in crystals and gross differences in rigs. When you suggest adding padders to the rig some guys rebel for fear of hurting resale value, and others because there is just not enough room.

The easiest answer I have found is to attach a small ceramic padder directly to a FT 243 case, using a longer screw through one of the upper holes in the body and cover plate, as shown in the drawing. If you are issuing crystals to a net, you can prefabricate these little assemblies so all the operator needs to do is apply a screwdriver. If he is a genuine appliance operator you may also have to supply the screwdriver. When the crystal is changed to another rig, it can be readjusted to suit.

This method works so well I have also

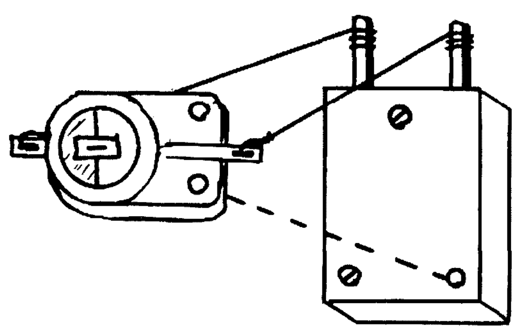

Fig. 1. Zero beat.

used it on one of my 2 meter FM rigs, which has socket provisions for only one crystal but which I like to operate on several frequencies. I removed the padder which was on the chassis and have a separate one mounted on each crystal. To the modern pushbutton set this may seem pretty strange, but for us old boys who used plug-in coils both in transmitters and receivers it seems merely a bit nostalgic.

. . .WA4UZM■

Marshall Funkey W6BMK
404 Alvord Street
Ridgecrest CA 93555

2 kW from Heath

The first amateur kilowatt transmitter I ever saw was 6 ft tall and weighed over a quarter of a ton. The SB-220 is 8 in. high and weighs less than 50 lb. The first kilowatt rig I ever built, around 1947, was 5 ft across and took four of us to lift onto the operating table. The SB-220 is only 15 in. wide and can be carried under one arm. We've gone a long way, guys, to get where we are today.

In the last few years, I've looked over all the popular linear amplifiers on the market and have wished many times that one was sitting on my desk. Until recently they were all out of reach; shoes and food for my five have first priority. I even made plans to build my own, but getting parts and finding time to build crossed that idea off my list. Then I saw the Heathkit linear and couldn't resist.

It took the truck lines over two weeks to get the SB-220 kit from Michigan to my location out here in the Mojave Desert in California. All this time they did their best to bust up the two cartons. They didn't get the job done, due to good Heath packing.

It sure was a happy day when my kit arrived. I canceled all plans for the weekend and spent the evening checking the parts list.

The electrical design follows what has almost become an amateur standard: broadband input, grounded grid, and pi-tuned output. You can get all the specifications and other good information from the Heathkit advertisements.

The mechanical design of this kit has been well planned. To get the power supply (which takes up one-third of the space) and the rf section in one little cabinet took a lot of careful planning. But they did it.

The assembly manual lives up to the Heathkit reputation of being the best in the business. One section in the manual that is very helpful consists of chassis photographs. I only wish a person could get real glossy prints so the details could be seen much clearer.

Safety is not left out. This high voltage could prove fatal. Not only do they provide a warning decal, but they designed an automatic discharge interlock that operates when the inside top panel is removed.

Bands: 80, 40, 20, 10m
Driving power: 100W
Duty cycle: Continuous
3rd order distortion: -30 dB
Output impedance: 50-75Ω unbal.
Power required: 120V at 20A or
240V at 10A, 50–60Hz
Cabinet size: 14 7/8 x 8 1/4 x 14 1/2 in.
Net weight: 47 lbs.
Heath Model Number: SB-220

Basic specifications

Construction was started on a folding card table and was all the space needed. Three muffin pans and a couple of cigar boxes, plus the packing boxes the kit came in held all the parts for easy accessibility. All the chassis photographs were removed from the manual and hung up for easy and quick reference. This helps in understanding the layout and detail drawings. No special tools are needed; I did use a pencil-type soldering iron with a small and large tip.

Carefully following the step-by-step assembly section of the manual, it took just under 20 hours to complete. Along with coffee and rest breaks, the weekend went by very fast. The "test and final assembly" section took another three hours. I ran into a few problems and made a list of things I would do differently next time. I had a chance to use this list when a doctor friend of mine asked me to put his together. It sure helped. I gave this list to a retired friend, and it saved him time and trouble the first time. (The list is available on receipt of SASE.)

Now came the problem that many of us have, and one of the reasons many amateurs feel a linear of this size is out of the question: ac power. The SB-220 will work on 120V, but requires a maximum of 20A. This is the most a 12-gage wired circuit can handle. What could be done is to operate the linear on one house circuit and bring an extension cord in from another house circuit to run the rest of the station. I live in a rented house, and this is what I did at first. I later ran a special extension cord to the clothes dryer outlet in the kitchen and picked up my 240V from there. We don't use a dryer here in the desert, so this made a good source of power. Keeping the cord out of the way required a few holes in the walls. Maybe an article on ac house wiring for amateurs would be a good thing to write about next.

We moved to a new house since constructing the SB-220, and this time we had to wire in a new 240V line to the operating position. That cost over 40 bucks just in materials. The SB-220 runs best on 240V, and you fellows that have it in your shack or can have it wired in have no problem. If you wire it yourself, make sure the local electrical code is followed to the letter, for your own protection. My 80 and 40 meter inverted-V antennas worked fine on low power; but for this high power, I added insulators at the ends where the high voltage could cause trouble. This proved to be a good move, and it didn't change the loading a bit. The loading control knob on the SB-220 seems to be very broad, no matter which antenna is being used. Guess I'll have to get a Heath scope to make my tuning more precise. The only real trouble I've had in using the linear has been of my own making. I sometimes forget to change the bandswitch when I go from band to band. This hasn't hurt the linear, but it sure makes the output meter pointer swing wild.

I enjoy working barefoot, but there come times during net operations or running a phone patch that a linear makes operating pure pleasure. I don't go looking for DX, but when a distant station answers the first time, man that's living! I've had no trouble running it on reduced power for RTTY 15–20 minutes at a time — this beats their specs by 100%.

The only dislikes that I have are purely personal. To ship the SB-220, it must be packed in a special shipping box. The other is the size; in this area, it doesn't match the other SB pieces of equipment.

All in all, this unit is a wonderful buy, at 17½ cents a watt! Heath sells many of these kits. Buy yours now, before the price of materials make the kit price go up. I like my SB-220 – I'm sure you'll like yours.

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STUDY GUIDE GENERAL CLASS LICENSE

Part X: The Listening Post

One of the oldest sayings in radio (attributed by some to Signor G. Marconi in the years preceding 1900) is, "You can't work 'em if you can't hear 'em." The direct implication of this maxim is that a good receiver is essential to any ham station.

Not only is a good receiver essential, but the FCC requires that any aspirant for the General class license have some knowledge of what goes on inside that receiver. While only three questions on the official study list of questions to help in preparation for the license exam involve receivers, those three between them manage to require a fairly complete knowledge of receiver theory.

In this chapter we're going to tackle those receiver questions, and while we're at it we'll take up SSB (single sideband). This isn't as farfetched as it might sound, because the generation of an SSB signal is mighty like the reception of just about any kind of signal.

The FCC study list questions we will deal with are:

40. List the basic stages of a conventional superheterodyne receiver and tell what function each stage performs.

44. What are the basic stages of a single sideband (SSB) receiver and transmitter and what purpose does each serve?

46. What are "images" in a receiver?

For a start, how about "What kinds of receivers exist?" The answers to this will help put the requirements of the FCC questions into perspective, as well as providing groundwork for several parts of the detailed discussion later. Then we can look at "What makes up a superhet?" and get the information to answer question 40, as well as a bit more. For SSB, we'll just ask the general query "How does SSB work?" and get the required block diagrams of transmitters and receivers along with a view of how SSB fits into the general communications picture. Finally, we'll try to determine "How is receiver performance rated?" This question might easily be considered first, but the ratings make more sense when the attributes being rated have some meaning.

We're biting off quite a mouthful for this chapter, so let's get right to chewing it up. If you're ready, let's go.

What Kinds of Receivers Exist?

The earliest kind of radio receiver on record was a device which today would startle almost anyone involved with electronics. It was "a circle which could be rotated within itself . . . made of copper wire 1 mm thick, and had a diameter of only 7.5 cm. One end of the wire carried a polished brass sphere a few millimeters in diameter; the other end was pointed and could be brought up, by means of a fine screw insulated from the wire, to within an exceedingly short distance from the brass sphere."

This receiver was used in 1888 by 31-year-old Heinrich Rudolph Hertz (the man for whom the unit of frequency is named) to demonstrate the existence of

"distinct rays of electric force" carried without wires, through space. The quotations are from his own description of the experiments, published in December 1888. The copper-wire loop was the complete receiver; the accompanying transmitter was a sparkgap arrangement, and the maximum distance between transmitter and receiver was limited to about 5 ft (when everything was working perfectly, amazing DX of 6 ft could be achieved).

After Hertz' experiments demonstrated the existence of radio waves, Marconi developed a communication system around them. The Marconi system used a "coherer" as the main part of the receiver; this was much more sensitive than Hertz' loop-and-sparkgap, but still nothing compared to today's apparatus.

By the time amateur radio began to become popular, the coherer was on its way out, having been replaced by the much-more-sensitive galena crystal. This was a first cousin to today's semiconductor crystal diodes, and operated in essentially the same fashion (but for more than 20 years no one suspected as much). Finally, during World War I, the vacuum tube came into use for radio reception, and a young Signal Corps major named E. H. Armstrong invented, in order, the regenerative receiver, the superregenerative receiver, and finally the superheterodyne circuit. The superhet is still the standard receiver circuit, although transistors and integrated-circuit chips are replacing the vacuum tubes Armstrong knew.

Despite the almost universal use of the superhet for serious communications today, the diode, regenerative, and superregen circuits are still very much with us. The popular "Twoer" and "Sixer" transceivers from Heath use superregen receivers, and most superhets include at their core at least one diode detector which is a direct descendant of the ancient "crystal set." Regenerative circuits are popular for beginners' construction projects and can deliver amazing performance with a minimum of components.

All these receiver types so far are for AM reception. For CW, the regenerative

and superhet circuits work nicely. The diode circuit and the superregen do not produce easily audible output from CW signals; the crystal set worked on the CW of its day only because the output of a sparkgap transmitter was not a clean CW signal, but instead was a raucous buzz (or smooth whine if the gap was driven by an alternator or used a rotary gap arrangement, as some of the large commercial installations did).

Almost all FM receivers are of the superhet variety, although a superregen will operate nicely on FM and even a diode circuit can perform creditably.

The modern standard, as we said, is the superhet. These come in several types, and we'll find out more about them in the next section.

What Makes Up a Superhet?

Before we can get very far in finding out what goes into a superhet circuit, we must look at receiver circuits in general. This, in turn, is going to take us back in places to the subject matter of our previous chapter, modulation.

For now, incidentally, we'll only be examining receivers for AM signals. Once we have them down cold we can proceed to the features required for other types of modulation.

The simplest practical receiver for today's signals is the diode detector, shown stripped to its basics in Fig. 1. It will work

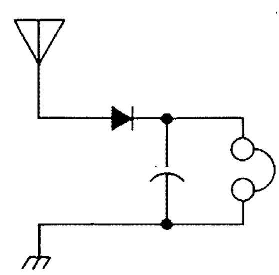
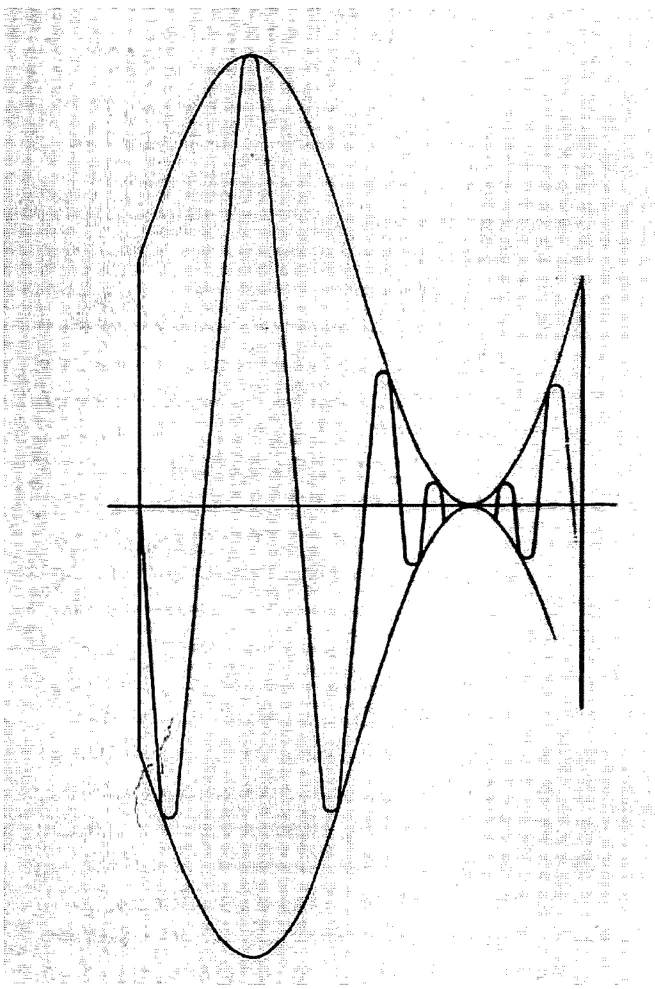


Fig. 1. Simplest radio receiver consists only of antenna, ground, diode, capactior, and earphone connected as shown.

just this way, too, if you care to try it. Incoming rf picked up by the antenna must pass through the diode and the capacitor (the inductance of the headphones acts as a choke) to reach ground. The diode, how-

ever, permits current flow in only one direction and blocks any reverse current flow. This results in production of a charge across the capacitor which follows the *peak* values of the radio-signal envelope waveform. The headphones are operated by this voltage. Fig. 2 shows the waveforms and



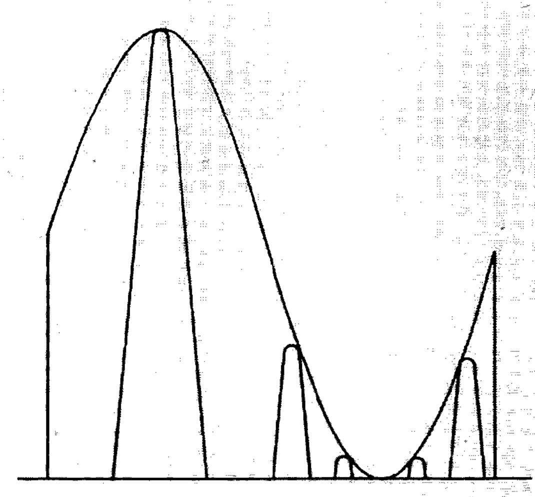


Fig. 2. Receiver of Fig. 1 operates by rectifying rf signal picked up by antenna (left waveform) and shaving off half the signal to produce the pulsating-dc output shown at right. This signal charges capacitor to peak voltage reached by each half-cycle or rf, and earphones respond to the audio envelope thus reproduced.

brings out how the rectifying action of the diode causes the modulation envelope to be reproduced across the capacitor.

Such a receiver as this will have little or no selectivity. That is, it will receive *all* radio signals which reach it. Most will not produce enough power across the capacitor to operate the phones, so if you try it you probably will get only the strongest broadcast station in your area (and if you live more than 15 to 20 miles from the transmitter, you may not get even that). Some degree of tuning is provided by the antenna, but that's the only control over what you get.

Obviously, this simple circuit suffers from three major problems. It is not very sensitive (cannot pick up weak signals), has poor selectivity (cannot separate a single signal from all the rest), and has low output (earphones only, and no control of volume).

Selectivity was improved in crystal-set days by adding tuning circuits between antenna and detector. As many as three or four separate tuned circuits were found in the fancier sets, and they helped to shave reception down to the desired signal. However, they could not produce enough selectivity to separate two signals only a few kHz apart – and they did nothing for sensitivity or output.

It took the vacuum tube to do much for receiver performance in the areas of sensitivity and output volume. The amplification made possible by the tube could be used at either radio frequency, to provide added sensitivity by producing a stronger signal to the detector than the antenna alone could produce, or audio frequency following the detector, to provide louder

output. Normally it was used both places – and still is.

Early vacuum tubes were expensive, and experiments were hard-pressed to obtain more than one at a time. Ingenious circuits were devised to permit this one tube to amplify the signal at rf, then detect it, and amplify the resulting audio some more, all in the same stage.

Then Major Armstrong came up with the regenerative detector, which made use of positive feedback to produce both exceptionally high gain and very sharp selectivity within a one-tube stage. For years, the regenerative circuit was the standard for both amateurs who could afford the tube, and commercial installations.

By this time researchers had realized that the particular set of problems represented by a radio receiver had no simple direct solution. Radio communications require high frequencies, but amplifiers give greatest gain at low frequencies. Similarly, selectivity requires sharp tuned circuits, but the higher the frequency the less sharp any tuned circuit becomes. These problems, as much as anything else, limited early radio to frequencies below the upper end of today's broadcast band. Available receivers simply would not operate properly at higher frequencies.

The regenerative receiver amounted to an oscillator with not quite enough feedback provided to sustain oscillation. This gave extreme gain and excellent selectivity. By this time, CW transmitters were replacing the noisy sparkgaps, and the regenerative receiver also turned out to be excellent for receiving CW signals (which the diode detector simply could not detect). All that was necessary was to push the receiver just over the line into oscillation; the oscillating receiver was then tuned to a frequency just a few hundred cycles off from that of the transmitter. The receiver's own rf mixed with the incoming rf from the transmitter to give a "beat note" or "heterodyne" signal equal to the difference between receiver and transmitter frequencies, and this pure tone was easy copy. This technique was known as "heterodyne reception".

While serving overseas during World War I, Major Armstrong had what was probably his most important of many new ideas. He saw how to eliminate all the problems of reception by applying the heterodyne principle in a new way. Rather than offsetting local and received frequencies by an amount in the audio range as was done for heterodyne reception, why not make the difference come out in the lower end of the rf range, at a point where good gain and the desired selectivity could easily be achieved. The resulting "intermediate frequency" signal could then be redetected into audio, after being amplified and shaved down as desired.

That was the "superheterodyne" idea, and it's still in use in essentially the same form its inventor first conceived. A superhet today will have, as a minimum, a local oscillator to provide the offsetting frequency, a mixer stage to combine the local and signal frequencies into the intermediate frequency or i-f, an i-f amplifier, a second detector, and audio stages. Most will also have one or more stages of rf amplification preceding the mixer (sometimes called the first detector), and if intended for communications use, will provide heterodyne action for the second detector.

Fig. 3 shows the stages of a single-conversion superhet communications receiver. The purpose served by each stage is described in the following paragraphs.

The rf amplifier's primary purpose in superhets operating below the VHF range is to isolate the local oscillator from the antenna and thus prevent interference by the receiver to other receivers. At VHF, the rf amplifier serves primarily to boost the signal strength and thus help overcome noise problems, but at HF and lower frequencies ample gain is available in later stages.

The local oscillator provides the "offset frequency" signal and thus controls the receiver's tuning. The receiver will pick up only signals which are separated from the local-oscillator frequency by the amount of the i-f frequency, and so changing the frequency of the local oscillator changes

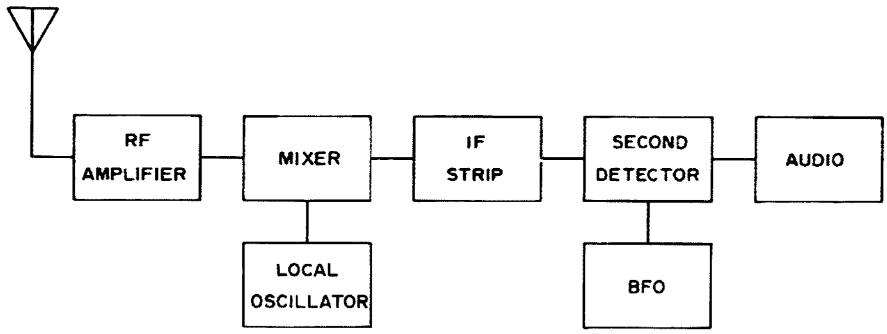


Fig. 3. Basic stages of a conventional superheterodyne receiver are shown here and described in text. Rf amplifier and bfo are not normally included in non-communications superhets for entertainment use, but are considered essential in quality communications receivers.

the frequency to which the receiver is tuned. The local oscillator must be stable; that is, its frequency must remain constant once set. Otherwise the receiver will "drift" off frequency and will require frequent retuning.

The mixer or "first detector" operates in the same manner as the amplitude modulator we examined in the last chapter, combining two input signals at different frequencies to produce four output signals which are at the two original frequencies, their sum, and their difference. Most often only the difference frequency is of interest. The mixer actually gets many more signals in, and produces many more out, because all the signals which make it through the rf amplifier stage are acted upon by the mixer. The relative frequency difference between different signals is much greater at the output than at the input, however, because the mixer essentially subtracts a constant (the local oscillator frequency) from each of its input signals.

The i-f strip is the heart of the superhet receiver. This block consists of one or more stages of rf amplification, operating at a fixed and relatively low frequency. For many purposes, the standard intermediate frequency is 455 kHz. At this low frequency, very sharp selectivity may be attained, yet good gain is still possible. The i-f amplifiers are set to one frequency and left there (a process called "alignment"), and thus the receiver's gain and selectivity are the same at any frequency within its tuning range. Because of its selectivity, the i-f strip accepts only one of the many signals appearing at the mixer output; all the rest are eliminated, but the one signal accepted goes on through and is amplified to respectable strength before reaching the second detector.

The second detector is essentially the same as the simple diode detector of Fig. 1; since both sensitivity and selectivity have been provided by the preceding stages, the only function of this stage is to convert the i-f signal into audio.

For reception of CW and SSB signals, a beat frequency oscillator (bfo) may be provided. This oscillator produces a signal offset from the i-f by a difference within the audio range; normally, it includes a "pitch control" which adjusts its output frequency to fall either side of the i-f. The bfo output is fed to the second detector along with the i-f when heterodyne reception is desired. In more recent designs, the bfo is sometimes included as part of a separate "product detector" circuit which is switched in to replace the second detector for heterodyne reception. We'll look at this more closely in the next section.

Once the incoming signal is converted to audio by the second detector or its equivalent, the audio is then amplified to drive a loudspeaker (if desired) by the audio section.

Everything has a price, and the performance of the superhet is no exception. Since the basic principle is that of converting an incoming signal to an intermediate frequency by mixing action, which produces both a sum and a difference signal, it's possible to receive two different signals simultaneously with a superhet. Such action is called "image" reception.

An example may make it clearer. Broadcast-band receivers usually have the local-oscillator frequency higher than that of the signal to be received (partly to minimize the image problem), and normally use a 455 kHz i-f. Thus when one is set to receive a station at 610 kHz (the low end of the band), the local oscillator will be set to 1065 kHz, 455 kHz higher, in order to produce a difference frequency of 455 kHz.

Unfortunately, with the oscillator at 1065 kHz, any incoming signal at 1520 kHz which happens to reach the mixer stage will also produce a 455 kHz output (1520 – 1065), which the i-f stage will not be able to distinguish from the desired signal. Thus the 1520 kHz signal can and will interfere with the desired one at 610 kHz.

The characteristic of image reception is that the undesired signal is always separated from the desired one by twice the i-f, and is on the other side of the local-oscillator frequency.

Another aspect of the image problem, which shows up on many inexpensive ham receivers, is the possibility of tuning the same signal in at two places on the dial. To reverse our previous example, you could tune in the 1520 kHz station either at its true frequency of 1520 kHz, or at the image point 910 kHz lower, 610.

As the signal frequency gets higher, with a constant i-f, the separation between true and image points becomes proportionately smaller. In the 40 meter band, for instance, 8 MHz commercial signals show up on top of 7 MHz ham signals, and the ham signals themselves can also be tuned in around 6 MHz if you like. By the time you get to the 10 meter region, ham signals at 29.5 MHz can be causing interference with other ham signals around 28.59 MHz.

Since the separation between true and image points is always twice the i-f, one solution to the image problem is simply to use a higher i-f. If the i-f is raised to 1600 kHz, for instance, the true and image points will be separated by 3.2 MHz, and then a single rf stage ahead of the mixer normally will reduce the image response to the point that it is not objectionable.

Unfortunately, the higher the i-f, the poorer the sensitivity and selectivity of the receiver.

One of the more ingenious solutions to this problem was the invention of the "double superhet" or "double conversion" system. This is essentially two superhets end to end, with the mixer of the second taking the place of the second detector of the first as shown in Fig. 4.

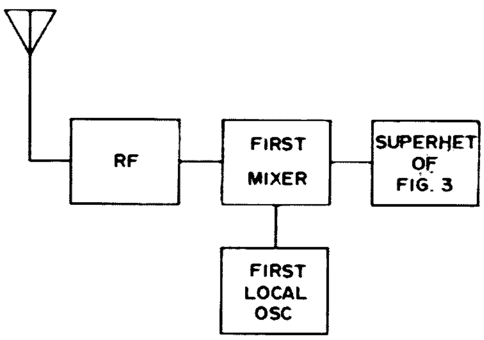


Fig. 4. Double-conversion superhet duplicates "front-end" circuitry of single-conversion superhet, then uses entire single-conversion superhet at output of first-mixer. Resulting composite circuit has two local oscillators, two mixers, and two i-f strips (rf stage of single-conversion receiver becomes first i-f of double-conversion circuit). Advantage is improved image rejection because first i-f can be relatively high frequency, while maintaining selectivity and gain with low-frequency second i-f.

The first i-f is picked for best image rejection, while the second is chosen for gain and selectivity. One popular receiver using the double-conversion principle used 1825 kHz as the first i-f, and converted this down to 85 kHz for the second to achieve high selectivity.

When double conversion is used, either the first or the second conversion oscillators may be tuned. Use of a VHF converter ahead of a tunable communications receiver is an example of double conversion with the second oscillator being tuned; the converter produces an i-f between 14 and 18 MHz, for instance, and the receiver then tunes over this band. Many high-performance receivers now make use of double conversion with tunable second oscillators in order to achieve high stability in frequency, and to get the same tuning rate on each band covered (since the tuning is always the same).

How Does SSB Work?

In the preceding chapter we made the acquaintance of "sidebands" and found that sidebands are necessary in any kind of modulated signal – in fact, that sidebands carry the information which composes the "modulation" of that signal.

We also saw that any modulated signal has two sidebands, one on either side of the carrier, which are mirror images of each other.

It follows from this that only one of the two is really necessary, and that the carrier isn't necessary at all. That is, the same amount of information could be transmitted if we simply didn't bother to transmit either the carrier or one sideband, just so long as we did transmit one of the two sidebands accurately.

Since with AM modulation the limit of 100% modulation is reached (with sine-wave signals) when the modulating signal has half as much power as the carrier wave, and since this modulating signal's energy is split between the two sidebands, that means that ¾ of the power transmitted from an AM station is useless; all of the information can be recovered properly from one sideband, which represents only 250W of the power transmitted from a 1 kW transmitter.

That's what SSB is all about – the technique of taking advantage of these facts, to achieve that 4-to-1 power advantage by concentrating all the transmitted power in the only meaningful part of the signal, and simultaneously to conserve space in the rf spectrum by holding the bandwidth of the signal down to half that of a conventional AM transmission.

Unfortunately, doing so is not so simple as we may have just implied. Getting rid of the carrier and one sideband requires special circuitry in the transmitter, and in addition SSB signals cannot be received as simply as can those from ordinary AM stations. The missing carrier must be put back into the signal at the receiver in order to recover the audio, and that's a bit of a job.

SSB has been in use since 1927, but until 1948 was applied only to commercial

telephone communications. The first ham station to use SSB was apparently W6YT, the Stanford University club station, but within a matter of weeks after W6YT appeared with SSB a number of other stations followed suit. Today, SSB is rapidly approaching the state of being the "standard" means of voice communication on HF ham bands.

A number of factors combined to produce the 21-year delay between first use of SSB and hams' acceptance of the technique. Most of them boiled down to the fact that at first, it was simply not simple enough to be practical for the vast majority of hams. Costly installations and special equipment were required. The advances in radio technique during World War II changed this situation and made it practical for hams to take up SSB operation.

Still, SSB is nowhere near as simple as ordinary AM, either to generate for transmission, or to receive. In addition to all the functions of a normal AM transmitter, the SBB transmitter must include facilities for removing the carrier and unwanted sideband from the signal. These normally operate properly only at low signal levels, and once the signal is converted into SSB it cannot be amplified by normal rf power amplifiers (which would introduce distortion). This introduces the requirement for linear amplifiers, which are more difficult and critical to adjust than are ordinary class C stages.

Once the signal is generated and transmitted, it must be received. Frequency stability is necessary in an SSB receiver, because a drift in receiver tuning of as little as 20 Hz is noticeable, and a 100 Hz drift renders the signal unreadable in most cases. The receiver must, in addition to having high stability, include provisions for putting the carrier back into the signal for detection, and this means that heterodyne reception is necessary.

Let's look at the requirements for both generation and reception of SSB signals, now that we have a general idea of how they differ from conventional AM techniques. We'll take the transmitter first.

Figure 5 shows a block diagram of a

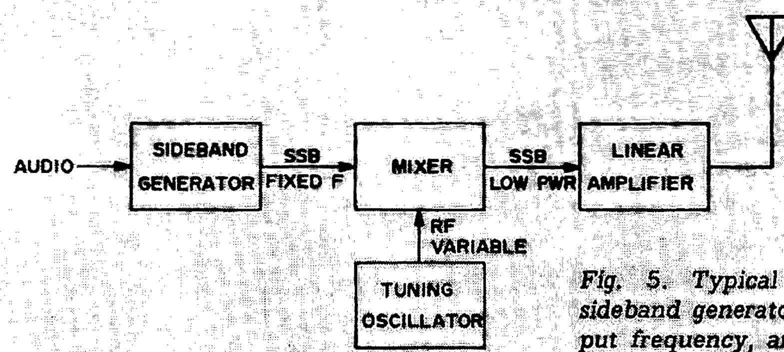


Fig. 5. Typical SSB transmitter consists of sideband generator, provisions for changing output frequency, and linear amplifiers. See Figs. 6 and 7 for details of sideband generators.

typical SSB transmitter, contrasted with that of a typical AM transmitter. The difference in complexity is obvious.

In the SBB transmitter, the audio is applied to a sideband generator stage where it is converted to an rf signal which reproduces the audio at some radio frequency. This is done by a variation of the normal AM process, but the carrier and unwanted sideband are removed before the signal gets out of the sideband generator. Output of the sideband generator is an SSB signal, but is not necessarily at the desired signal frequency because it turns out to be much simpler to always generate the SSB signal at the same frequency, and then translate it by a mixing operation to the desired frequency for transmission.

Sideband generator output, therefore, is applied to a mixer stage, and an output-frequency tuning signal is applied to the mixer's other input. This output tuning signal may be obtained either from a fixed-frequency oscillator such as a crystal circuit, or from a stable vfo. The mixer's output includes an SSB signal at the desired output frequency, which is selected and amplified to the output power level by means of linear amplifiers.

The sideband generator stage is the heart of the SSB transmitter, and warrants additional examination. At least three different techniques for sideband generation are known, but only two of these are used in practice. They are known as the "filter method" and the "phasing method."

Both the filter and phasing methods make use of "balanced modulator" circuits, which are special types of mixers which eliminate one of the two input signals from their outposts. These balanced mixers are usually set up to eliminate the carrier signal, because the audio signal (at a far different frequency) can easily be rejected by tuned circuits. Output of an SSB balanced modulator, then, usually consists only of the two mirror-imaged sidebands which result from the mixing process.

Figure 6 shows a block diagram of a filter-method sideband generator. Incoming audio and the rf carrier signal are applied

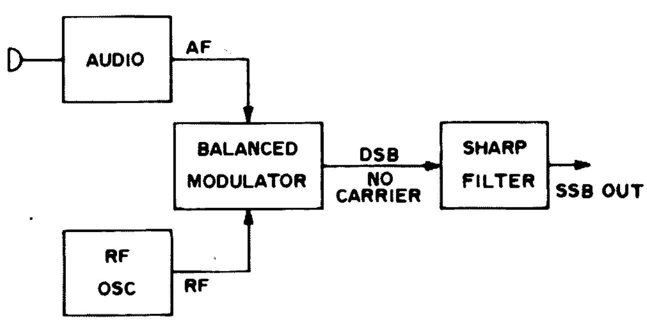


Fig. 6. Filter-method sideband generator converts audio and fixed-frequency rf into double-sideband suppressed carrier signal using balanced modulator, then filters away one sideband to produce SSB. Filter may use crystals or mechanical technique, and may operate at frequencies from 17 kHz up to 9 MHz.

to a balanced modulator, where the original signals disappear. Output of the balanced modulator is a double-sideband (DSB) signal with both carrier and audio suppressed. This DSB signal is then passed through an extremely sharp filter, which shaves off one of the two sidebands, and passes the other relatively unaffected. Output of the filter, therefore, is the desired single sideband signal.

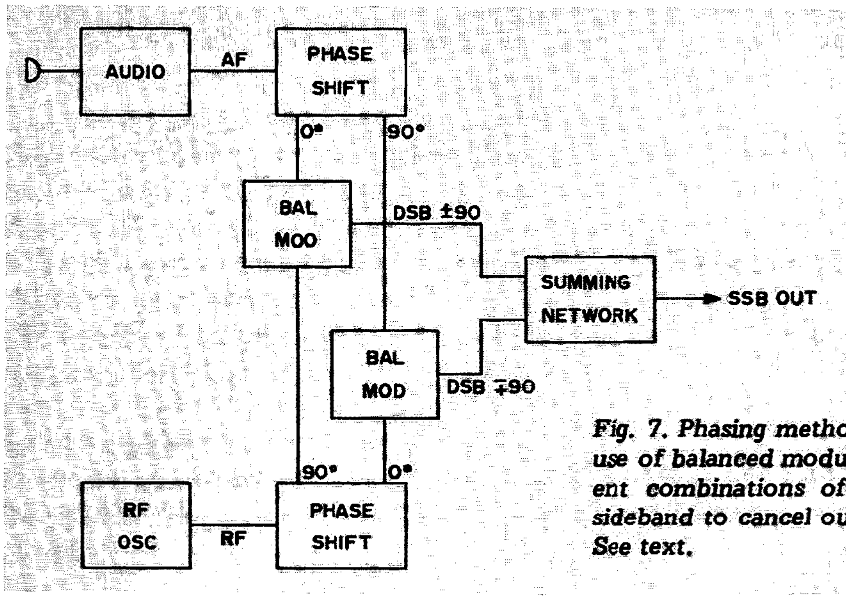


Fig. 7. Phasing method of SSB generation makes use of balanced modulators operating with different combinations of input signals forcing one sideband to cancel out in the summing network. See text.

The phasing method (Fig. 7) is more complex, but eliminates the need for the sharp (and costly) filter. Incoming signals, both audio and rf, are applied to phase-shifting networks. The phase shift networks produce pairs of outputs, which are identical except that they differ from each other in phase by 90 degrees.

One audio-rf pair is applied to once balanced modulator, and the other pair goes to a second balanced modulator. Outputs of these two balanced modulators are double sideband signals.

The balanced-modulator outputs differ from each other in phase, however. Because of the phase shift introduced into the signals before mixing, one sideband (either the upper or the lower one) will have the same phase in both modulator outputs, while the other sideband will have a 180-degree phase difference between one modulator output and the other.

The two outputs are combined in a summing network, where the sideband with no phase difference survives while the one with 180-degree phase difference cancels itself out. The output of the summing network is, therefore, the desired single sideband signal.

Both the filter method and the phasing method have advantages and disadvantages. The filter is simpler in concept, but requires components which are usually more costly. On the other hand, phasing is less expensive but requires more critical adjustments. Either technique is capable of producing outstanding results – or garbage, depending upon the skill and care of the operator.

Once the sideband generator produces an SSB signal, regardless of the method used to obtain it, the mixer (Fig. 5) translates it to desired output frequency and its power level is determined by linear amplifiers.

Now that we understand how SSB is generated and transmitted, let's look at how it is received:

Almost any receiver capable of copying CW signals *can* be used for SSB reception, but for generally satisfactory results an SSB receiver should have high frequency stability, a slow tuning rate, and sharp selectivity. We've already seen why stability is required. The tuning rate goes right along with it; when a 20 Hz error causes distortion, you want to be able to make fine tuning adjustments slowly.

The selectivity is required in order to take maximum advantage of SBB's narrower bandwidth. Best use is made of a signal if the receiver bandwidth exactly matches that of the signal, because if the receiver covers a wider band than the signal occupies, the leftover space will contribute noise to the receiver's input and thus degrade total performance.

The receiver must be capable of heterodyne reception to recover the audio from the SSB signal. Detection, like modulation,

is actually a mixing process. In a conventional AM detector, the sidebands are mixed with the carrier, and the difference frequency (which is the audio involved) is taken as output. Since the SSB signal has no carrier to mix against, an external carrier must be supplied.

SSB forced recognition of the basic identity of modulation, detection, and mixing – and led to improved techniques for detection when the principles long established for mixer operation were applied. The resulting circuits are now known as "product detectors" and provide outstanding performance forboth CW and SSB signals.

A good agc system is convenient to have in an SSB receiver, because the signal strength varies widely and rapidly. This creates some problems, because conventional AM receivers drive their agc (sometimes called avc) systems with a signal derived from the carrier strength (the same signal drives the S-meter), and SSB has no carrier. The problems have been solved in many different ways, and again CW operators as well as SSB users have benefited.

The block diagram of a typical single-conversion selectable sideband receiver intended for AM/SSB/CW operation is shown in Fig. 8. The circuit may be compared with Fig. 3, which shows the conventional version of a similar receiver. You can see that the sideband receiver contains all the functions required for ordinary reception, and merely adds a few new ones to handle SSB.

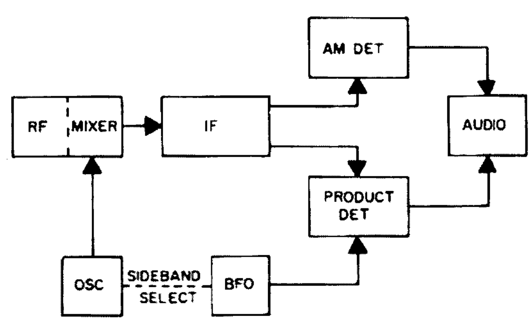


Fig. 8. Selectable sideband receiver shows great similarity to ordinary receiver (Fig. 3), but with added extras to facilitate SSB reception. Actually, any receiver capable of receiving CW can tune in SSB, but extra features shown here are needed for extended use.

The purposes served by these added functions have been indicated in the preceding paragraphs. Naturally, many more functions *could* be added. For instance, most selectable sideband receivers involve double-conversion techniques to achieve sideband selection. For this, add the features of Fig. 4.

How Is Receiver Performance Rated?

Now that we know all that we need to at this stage about both receivers and SSB operation, let's look at the factors by which various receivers are rated and compared with each other.

We've been using some of these factors all the way through without bothering to specifically define them. This is the point at which we will rememdy that situation and provide definitions.

The three major performance points involved in rating receivers are (1) sensitivity, (2) selectivity, and (3) stability.

Sensitivity is a measure of how weak a signal can be received, or to put it another way, of how strong a signal must be in order for the receiver to pick it up. Different techniques for measuring sensitivity are used in different parts of the frequency spectrum. In the normal ham bands, a measurement of signal level in microvolts (μV) is about as frequently encountered as is any other rating. The smaller the rating, the more sensitive the receiver. That is, a receiver rated at 1 μV sensitivity is ten times as sensitive as one rated at 10 μV, all other conditions remaining equal.

It's necessary to be cautious in comparing receiver sensitivity ratings, though, because the "microvolt" rating is meaningful only when the impedance across which this voltage is to be measured is specified. For instance, a receiver rated at 10 μV across 300Ω does *not* have the same sensitivity as one rated at 10 μV across 75Ω. The first receiver is four times as sensitive as the second, because when impedance is stepped down so is the voltage, and 10 μV at 300Ω is equivalent to 2.5 μV at 75Ω.

Selectivity measures the receiver's abil-

Tell Our Advertisers You Saw It in 73

Even if you didn't.

ity to separate signals which are close to each other in the spectrum. Again, there are many different ways to rate this ability. The normal way is to specify a bandwidth, or two bandwidths, together with a rejection level. If only a bandwidth is given, the rejection level is normally understood to be 3 dB or 70% voltage (half power).

Thus a 10 kHz bandwidth rating for selectivity does not mean that a signal 11 kHz away will be totally rejected. It means only that signals 10 kHz from the frequency to which the receiver is tuned will be reduced in strength to 70% voltage or half power.

If 6 dB bandwidth is rated at 6 kHz and 60 dB bandwidth is rated at 12 kHz, though, excellent selectivity is indicated. This says that signals 6 kHz away from center frequency will be cut to half voltage, and those just twice that far away will be trimmed to 1/1,000,000 their voltage level. This amounts to complete rejection, in most cases.

Another facet of selectivity has to do with "image rejection." This is a quality unique to superhet circuits, which we met earlier. Image rejection is usually rated in dB, and refers to the amount of rejection of the unwanted or "image" frequency which is achieved. Anything better than 60 dB is excellent; many good receivers do not exceed 35 dB image rejection.

Stability, the final major performance point, refers to the receiver's ability to stay tuned to one spot over a period of time as the equipment heats up during use. Stability is often rated in terms of frequency drift, which in turn is usually quoted as so many cycles per unit of time. For instance, some receivers are rated for frequency stability "better than 20 Hz per hour," which says that this receiver will remain within 20 Hz of the spot to which it is tuned for at least an hour without readjustment of the tuning controls.

Less major performance points, but still important rating factors, include such items as the frequency coverage of the receiver, its power requirements, nature and level of audio outputs, etc.

Communications receivers usually come in one of four main categories with respect

to frequency coverage. Commercial users often employ fixed-frequency receivers, which are permanently tuned to a single frequency. These find little use in ham work except for the VHF FM nets operating on a basis similar to police or taxicab radio dispatch networks.

In addition to the fixed-frequency group, receivers may be "general-coverage," "continous coverage," or "ham band only." Inexpensive receivers are often general-coverage types, enabling reception of SW bands other than ham bands. The ham-band-only receiver, being designed to cover a smaller frequency range, often gives more performance per dollar since the design need make fewer compromises. Price is usually higher, however, because of limited demand for these units in comparison to the market for general entertainment receivers. Continuous coverage receivers are seldom seen; they provide complete coverage of their portions of the rf spectrum with no omitted regions. Normally these are laboratory instruments. Some military receivers, however, are of the continuous coverage type, and occasionally appear in surplus and so reach the ham market.

Rating for power requirements and audio output is self-explanatory. These ratings must be compatible with your desires, or the receiver won't do you much good. It's worth noting that most better receivers do not provide a loudspeaker as standard equipment; it's an extra-cost option, because for many communications uses the speaker is unnecessary – and when it is, its characteristics may vary from job to job. . . .Staff■

73 Reader Service Coupon

Now we don't say that every single reader must buy every last product advertised in 73. We believe that, but we don't say it. The very least every reader can do is put on a show of interest in the products herein advertised. To make this a simple task, even for the laziest reader (now there is a contest for you!), we have cleverly arranged the advertising index to double as a reader's service coupon. All you have to do is tear it out (or photocopy it) and send it in with the appropriate boxes marked. (We have a prize for the most boxes marked . . . a silent prayer of thanks from the publisher). We'll accept postcards, slips of paper, or almost anything else that lists the companies you want to hear from and your address.

No one likes to go into a store without buying something, right? It is the same with these information requests. You will be expected to buy something. Oh, it doesn't have to be a $50,000 antenna system, but it should be something modest . . . a transceiver . . . a linear . . . you know. We'll leave the decision up to you, knowing that we can trust you to do the right thing.

And we are definitely not saying that the use of this service coupon has any curative powers, but we cannot but notice that many readers report remarkable relief from simple backache, headaches, lumbago, and acid indigestion after sending in their coupon. Why take any chances?

ADVERTISER INDEX

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PROPAGATION CHART
J. H. Nelson

Good: Open/Fair: O/Poor: □

July 1971

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4	5	6	7	8	9	10
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EASTERN UNITED STATES TO:

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ARGENTINA	14	14	14	14	7	7	14	14	21	21	21	14
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ENGLAND	14	7	7	7	7	14	14	14	14A	14A	14	14
HAWAII	14	14	14	7A	7	7	7	7B	14	14	14	14
INDIA	14	14	7B	7B	7B	7B	14	14	14	14	14	14
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U. S. S. R.	14	7	7	7	7B	14	14	14	14A	14A	14	14
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

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ARGENTINA	21	14	14	14	7	7	14	14	14	21	21	21
AUSTRALIA	14	14A	14	14	7B	7B	7	7	7	7B	14	14
CANAL ZONE	21	14	14	14	7	7	14	14	14	14	21	21
ENGLAND	14	7A	7	7	7	7	7A	14	14	14	14	14
HAWAII	14A	14A	14	14	7A	7	7	7	14	14	14	14
INDIA	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	7A	7	7	7	7	14	14	14	14
MEXICO	14	14	7A	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
PUERTO RICO	14	14	14	7	7	7	14	14	14	14	14	14
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WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
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ARGENTINA	21	14	14	14	7	7	7	14	14	14	21	21
AUSTRALIA	21	21	21	14	14	14	7	7	7	7B	14	21
CANAL ZONE	14	14	14	14	7	7	7	14	14	14	14A	14A
ENGLAND	14	7A	7	7	7	7	7	7A	14	14	14	14
HAWAII	21	21	21	14	14	14	7	7	14	14	14	14A
INDIA	14	14	14	14	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	14	14	7A	7	7	14	14	14	14
MEXICO	14	14	14	7A	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	14	7A	7B	7B	14	14	14	14
PUERTO RICO	14	14	14	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7B	7	7	7B	7B	7B	14	14	14	14	14
U. S. S. R.	14	7B	7B	7	7	7	7	7B	14	14	14	14
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

A = Next higher frequency may be useful also.
B = Difficult circuit this period.


AMATEUR
RADIO
73
#131
August 1971
One Dollar
A 73 DXPEDITION ?
K4MJZ SAILS
THE CARIBBEAN
852

73 MAGAZINE

#131 AUGUST 1971

FEATURES

STAFF

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73 Magazine is published monthly by 73 Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas, $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough, N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. Entire contents copyright 1971 by 73 Inc., Peterborough, N.H. 03458. Phone: 603-924-3873. Keep your ears clean and listen for news which should be on our news pages. Send it in.

Cover: The 73 DXpedition to the Caribbean gets under weigh. Tex will stop and operate from every rock that sticks out of the water at high tide if you ask him to. See the poll on page 55 and put your oar in the water. For that matter, Tex will be delighted to have you visit with him anywhere and take a turn or three at the rig.

Amateur Radio News Page

AUGUST MCMLXXI | Monthly Ham News of the World | 73 MAGAZINE

73 GOES TO SEA

Tex Zammit (K4MJZ), like most DXers, has dreamed of going on a DXpedition. After kicking the idea around of combining his passionate interest in yachting with ham radio, he has come close to going on a DXpedition many times. However, his plans never materialized. Finally, last New Year's Day, he bought a 41-foot sailing cutter and found himself DXpedition bound.

This might be the beginning of a typical DXpedition if Tex had not been urged to talk with Wayne Green (W2NSD), publisher of 73 Magazine and a veteran of DXpeditions to KS4, JY, 9N1, YA, FO8, and 5W1. Together, the two men planned the first mail-order DXpedition. Rather than picking a rare spot and operating, Tex is asking 73's DXer readers to pick out the islands, countries, bands, and modes to be heard on a lengthy sail through the entire Caribbean area. Islands visited will be those most needed by the most people. Hams vacationing during the DXpedition can sail aboard the ship, the *Reverie*, as a crew member (while paying their own way). In addition, 73 Magazine will be handling all the QSLs for the DXpedition along with issuing a series of awards for working Tex in the various island groups.

outfitting post before the actual Caribbean DXpedition gets underway.

Immediate plans call for some cruising around the Bahamas from mid-August until mid-September. At this time Ken Raupach (WA4CYX) will be aboard for some sailing and operating. K4MJZ/VP7 will be the call used throughout the Bahamas and VP2VAH the call issued for British Virgin Island operation.

The *Reverie*, possessor of a ten year history of racing triumphs, is easily spotted by the ham-yachtsman. Generally run sloop rigged, she is a 41 foot Owens cutter with a deep blue bottom, white water line, and light blue topside. She will generally be flying the signal flags "73" when entering and leaving U.S. ports.

Not until September will the *Reverie* begin her DXpedition in earnest. It is hoped that there will be time for all those interested in this unique DXpedition to send in the coupon (page 55) with the islands that they would most want to work, the mode they would prefer to use, and the bands. Equipment is posing a problem, but with luck, even 80 and 160 meter operation is contemplated. As results come in, an itinerary will be made up with dates, locations, possible operating frequencies, and calls to

FCC ACTS:

VHF HOME CONSTRUCTION TO BE STOPPED?

The FCC has recently been cracking down on an old and ignored rule which could have profound effects upon amateur radio. In Part 15 of the FCC regulations there is a rule which states that receivers for use above 30 MHz must be certified as being within the regulations on spurious emissions.

The intent of the rule seems to have been to put the responsibility for receiver emissions of television sets, CB receivers, etc., upon the manufacturer rather than on the consumer. This is not unreasonable since few users would know what to do about interference their receivers might be causing. Manufacturers of commercial VHF equipment for sale to the general public have been meeting the requirements of Part 15 and have been having their receivers certified. This is not a simple procedure, but one which requires the use of extremely expensive laboratory equipment such an panoramic receivers, etc.

The application of this old rule to equipment for sale to radio amateurs is new and has manufacturers in a big stew. Some factories have had to hold up the shipment of two meter FM equipment for over two months while

FLIGHT TEST:

AMSAT AIRCRAFT I

OSCAR & SYNCART PLANS ADVANCED

The weekend of May 15th and 16th marked a major event in the short history of the Radio Amateur Satellite Corp. (AMSAT). Honoring International Telecommunications Day (May 17), which commemorates the founding in 1865 of the International Telecommunications Union, a breadboard model of a 2 to 10 meter repeater was flown aboard a light aircraft over a route which included most of the northeastern part of the U.S.

The repeater received signals between about 145.9 and 146.0 MHz and converted them to 29.45 – 29.55 MHz. A beacon signal on 19.45 mHz enabled acquisition of the aircraft even when no signals were coming through. Liaison for the AA-1 flight was provided by a net operating on 7225 KHz with WA1IOX at the Talcott Mountain Science Center, Avon, Conn., as net control.

The plane left Friendship airport about 9 AM EDST on Saturday, May 15, heading northeast toward Boston. It passed over Manchester, N.H. and turned westward toward Rochester, N.Y. From there the route was over Canada to Pontiac, Michigan. Sunday morning they headed aross lower Michigan to South Bend, Ind. and then south over Kokomo, Ind.; turned east to Columbus, Ohio, and back to Friendship.

The AMSAT aviators were pilot Jim Cristo (no call), Joe (Skip) Raymond, WA4EAG, Co-pilot; and Jan King, W3GEY, in charge of the repeater equipment.

Literally hundreds of stations participated in the test, as witnessed by the list made aboard the plane by W3GEY. The contributions of W8FSO in the communications network was particularly noteworthy as he was in contact with the plane during a good portion of its trip west across Canada as well as itsts flight east across Ohio and West Virginia.

Others flights are planned for the months to come before the A-O-B satellite is launched. Some may involve the 2 to 10 meter repeaters used on this flight, but others may take aloft a 432 MHz or 146 MHz repeater being constructed by DJ4ZC in Germany or a 4-channel FM repeater being constructed in Australia.

OSCAR & SYNCART

AMSAT is currently engaged in two major efforts, the AMSAT-OSCAR-B (A-O-B) and SYNCART (Synchronous Amateur Radio Transponder) amateur satellite projects. Approval to launch A-O-B was received from NASA on February 23, and it is hoped that SYNCART will be approved by NASA later this year.

SYNCART, proposed to NASA as an experiment for the ATS-G Applications Technology Satellite, represents an opportunity to achieve a high-power, long lifetime amateur communications relay on a synchronous satellite to be placed into earth stationary orbit around 1975. ATS-G is planned to contain a thirty-foot parabolic reflector capable of providing high-gain earth coverage in the VHF amateur bands. AMSAT has proposed to provide as part of this satellite, on a non-funded basis, a 20 watt PEP linear repeater capable of handling 20 to 50 amateur transmissions simultaneously using a frequency of approximately 145.9 MHz for the amateur-to-satellite link, and approximately 432.2 MHz for the satellite-to-amateur station downlink.

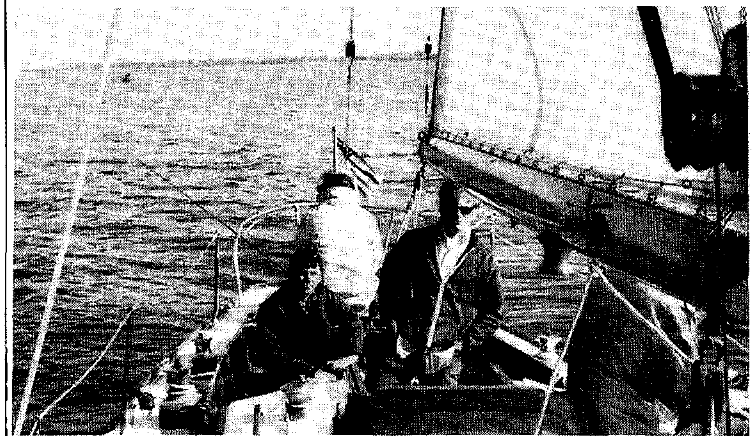
SYNCART'S projected lifetime of several years will effectively open 200 KHz segments of the two meter and seventy centimeter amateur bands for long-distance use by amateurs in North, Central and South America on a full-time basis.

AMSAT-OSCAR-B (A-O-B). AMSAT's primary efforts are concentrated toward the development of a series of long-lifetime operational satellites that can be used for everyday amateur communications. AMSAT-OSCAR-B, the first satellite of this series now under construction, will bring satellite communications to a broader base of amateurs for such activities as contests, DX and traffic handling. In addition, a series of aircraft flight tests with the AMSAT-OSCAR-B satellite repeater is planned to provide training and stimulate interest in preparing for amateur satellite communications. a launch early next year. Three repeaters are under development for this series of satellites, one in Australia, one in Germany, and the third in the United States.

Courtesy of AUTO-CALL *June 1971*

The *Reverie* has been overhauled and extensive sea trials have been completed – including experimentation with kite borne antennas. Stores have been brought aboard and by the time you read this, the *Reverie*, and guest operator Rick Rice (WA4YNN), will be sailing towards West Palm Beach, Florida. This will be the U.S. port of departure and final be used. It will appear in 73 Magazine along with details on the awards program, QSLs, and donations.

Hurry, then, to send in the coupon on page 111 with a list of the islands you need the most – in the order that you need them, and the bands and modes on which you would like to work them. Send it to DX Editor, 73 Magazine, Peterborough NH 03458.



On board *Reverie*. Tex K4MJZ is seated in the cockpit.

submitting their receivers for the necessary certification and okay by the FCC. Needless to say this has cost this already hard hit industry hundreds of thousands of dollars in income.

A well known legal firm which deals primarily with the FCC has examined the Part 15 regulations and opined that once the FCC has decided that manufactured ham equipment comes under this regulation, there is no way short of a change in the regulations for them to avoid including all home-built amateur receivers for use above 30 MHz in the same interpretation. Of course it is not all unknown for the FCC to come up with some fascinating interpretations of their own regulations and, if they want, to just turn their collective heads and ignore flagrant violations. Hopefully this is what the powers that be at the FCC have in mind for amateur builders of VHF gear. Certification, while possible in principle, would seem in practice to be beyond all but the most affluent amateur and the application of Part 15 to home-made receivers would probably end home construction once and for all.

JOHN GORE SCHOLARSHIP

The John Gore Memorial Scholarship is awarded each year to a licensed radio amateur who is studying for a career in electronics or related science. The scholarship for the academic year 1971-1972 pays $500. Information may be obtained by writing the Scholarship Committee Chairman, Henry DeCourt, W3WZN, 8101 Hampden Lane, Bethesda, MD 20014.

LICENSE EXPIRATION NOTICE SERVICE

Don't let your license expire because you forgot the renewal date! Send a self-addressed, stamped, postcard to the License Expiration Notice Service. At the top left edge write the date (month and year only) when you want the card to be mailed back to you. Write anything you want to say to yourself on the card. The card will be mailed on the date indicated.

This is a volunteer service and the Foundation cannot accept any responsibility for its operation. However, it has been working efficiently for 8 years. If for any reason the service should be discontinued, your card will be returned to you. Send your card to: **License Expiration Notice Service, Joan Machinchick, K3KBI, 1023 Lake Claire Drive, RFD 4, Annapolis MD 21401.**

EDITORIAL BY WAYNE GREEN

SEXY COVER PICTURES

Time was when a partially clad chick on the front cover (or anywhere in the magazine, for that matter) would bring in a raft of bitter complaints from Scoutmasters, clergy, and assorted party poopers. Apparently those days are definitely gone by – or perhaps they are busy writing to Playboy and the X movie crowd. At any rate, our recent covers have brought naught but huzzahs.

A sexy photograph in the mail every now and then brightens up an editor's mail, making his day a bit more complete. So be it known that I am still keeping an eye peeled for cheesecake, amateur radio style. If the young lady has a ham ticket so much the better – or perhaps she is the XYL or YL – no matter as long as she looks gorgeous and has some ham gear or an antenna in the picture somewhere.

For example, here is a shot of my wife Lin, complete with memories of the February cover shot of her on skis. This wasn't quite hammy enough to make the cover, but it seemed a shame to just pass it up entirely.

Eddy W5ZBC sent in this picture of Dianna Risinstein, Miss Louisiana Un-

include both of those frequencies in the RACES allocation, thus enabling the Radio Amateur Civil Emergency Service groups to utilize existing repeater installations. AFter all, RACES doesn't take an awful lot of time each week, and the "public service" aspects of this application of the repeaters might be just one extra feather in our collective hats.

The "standard" separation between repeater inputs and outputs is 600 kHz, as you probably know by this time. Look at those RACES allocations and you'll see that no such spacing is possible with that frequency grouping.

Are the RACES folk just going to make do without repeaters and struggle along with their nice old Goonie Boxes, or are they going to try and aim more at the state of the art by shifting to FM and repeaters? Repeaters are the obvious answer to emergency operation, of course. A repeater enables all of the mobiles, base stations and even hand units. to talk with each other over a very wide area, extending even little one watt pocket units so they can reach out perhaps 50 miles.

Perhaps things are not as snafu as they appear on the surface, though my contacts with government agencies gives me little reason to have any honest hope about this. I will welcome letters from interested or involved readers on the subject.

Technicians Above 147 MHz?

There is not, at this writing, despite what you may have read in the June

promising, events rise up and force a delay.

A couple of months ago I asked if anyone was interested in going to Europe this year. Sure enough, many of the amateurs and their wives who went with us in 1963 sent in their reservations immediately. Then, just as things looked bright, came the change in editors and I found myself tied again to that inexorable monthly deadline . . . a deadline that will not permit any three-week absences, even for things as valuable and fun as Europe. Well . . . maybe next year?

Spectronics

Art Housholder (Spectronics, Ill.) called to ask that I clarify the implication in the K6MVH editorial in June that he was directly involved with the new R.P.T. Magazine. Art explained that his interest is simply that of an avid fan and that neither he nor anyone else directly connected with Spectronics, Inc. has any financial interst in R.P.T.

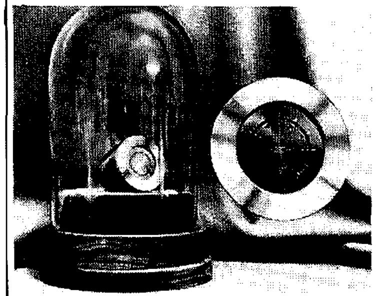
Ads = Pages

This issue of 73 is a lot thinner than I like. With a little help from you I could easily make each issue run from 144 to 160 pages. The hard economic facts are simple: we can publish about four pages of magazine for every page of ads. A 144-page magazine must have about 36 pages of ads to break even. With a bit of help from you I think we could get the 36 to 40 pages of ads that we need to bring you a big fat magazine every month.

If you like the idea of having ten to twenty more interesting articles in 73 every month, perhaps you will give me a hand in convincing the advertisers that it is important to them to support 73. What can you do to help?

1. Send in the reply coupon on page 112 (or a copy . . . or just a list of the companies you want to send you info). Send in one for friends, fellows you work on the air who want info, etc.

2. The advertisers in 73 are making it possible for you to enjoy the



The desk clock shown in the photograph does have one thing in common with a sundial . . . there are no moving parts. This unique time piece was built by the Motorola Semiconductor Products Division Central Research Laboratories, at a developmental cost of about $25,000 and displayed at the Electro-Optical Systems Design Convention in Anaheim, California to demonstrate what can be done with semiconductors and what could happen with the clocks and watches of the future.

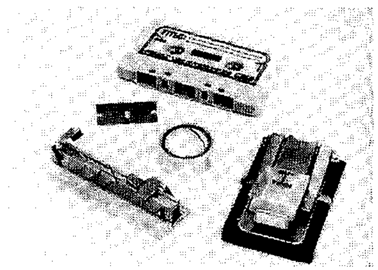
This clock represents three departures from the conventional design. First, there are no moving hands; instead, there are 72 light-emitting diodes arranged in two circles. The outside circle is made up of 60 diodes and marks the seconds and minutes. Each second or minute is marked by an apparently moving red light as the circuit switches power to the appropriate diodes in sequential fashion. The inside circle of 12 diodes marks the hours in the same fashion. With this arrangement, only 3 diodes are turned on at any one time. This is an important design aspect because the diodes draw current which, in the case of portable clocks, must be supplied by a small battery. With this newly developed system, it is expected that 2 small batteries can drive the clock for about one year before needing replacement.

NEW PRODUCTS

CASSETTE TAPE SPLICERS

Two new cassette tape splicers have been introduced by GC Electronics as part of its Audiotex product line. The manual model – 30-652 "Eze-Splice" – is priced at $2.95 and consists of a splicing block with felt-tipped tape hold-down clamps.

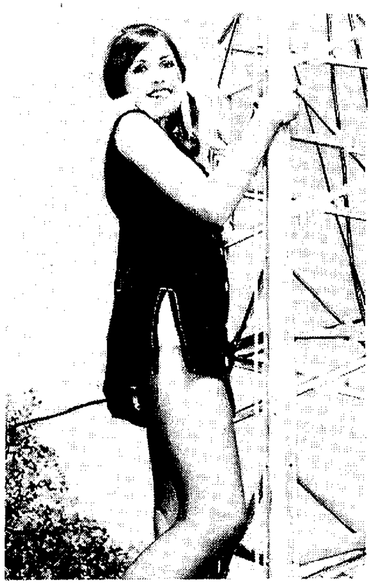
The second model in the line, 30-650, is priced at $4.95. It has two blade positions, one for cutting while the other provides a tapered trimmed splice. The new splicers are among the first on the market specifically designed for the hard-to-handle 1/8-inch wide cassette tape.



Both devices are suitable for editing and for repairing broken cassette tape. The 30-652 is supplied with a separate cutting blade. The 30-650 is semiautomatic and has a built-in blade for making the diagonal cut and an integral pair of cutting blades for aftersplice trimming. Two felt-tipped tape hold-down "fingers" provide an important "third hand" needed when splicing tape. *GC Electronics Division of Hydrometals, Inc., 400 South Wyman Street, Rockford IL 61101.*

PERSONAL PORTABLE VHF FM TWO-WAY RADIO

Aerotron, Inc. has announced the first of a series of "Shirt Pocket Size" hand-held, two-way radio equipment. The new Aerotron "600" series are compact, durable and easily serviced. The unit features 1W audio section and is available in the frequency range



iverse, climbing his tower. This is the kind of photograph that might make it for the cover. Keep in mind, if you are shooting for our cover, that the picture must be a vertical one – that room should be left for the title of the magazine on the left side – and that it should be made with a minimum of a 2¼" negative. 35mm doesn't make it for this type of work. Black and white only, by the way. We'll have to have a lot more advertisers before we go back to spending the equivalent of a 16-page section of the magazine for a full color cover photograph.

RACES

It is interesting – almost fascinating – to note that the RACES allocations on two meters run from 145.20–145.68 and 146.82–147.33 MHz, thus making it totally impossible for the RACES nets to use the existing FM repeaters and crystal combinations.

Since there are only a few areas of the country where repeaters are not functioning on 146.34/94, it would seem almost excessively logical to QST, any regulation prohibiting Techs from using repeaters with output above 147.000 MHz. There eventually may be, since there is a question with respect to the legality of the Tech "operating" the repeater transmitter in a band he is not licensed to use. Perhaps it will be necessary to resort to sophistry to continue the concept that the repeater owner is actually "operating" his repeater, while the user is just using it and not actually in control. True, the carrier of the user does turn on the repeater transmitter, but is this really the same as the user "operating" the repeater?

I, for one, would like to see the regulations interpreted in their broadest sense so that all repeater transmitters could operate within the bands allocated to the repeater owner or trustee. This would help to open up repeater operation onto the lower bands, a trend that I hope will come. How great it would be if a tone actuated relay could put a repeater onto a 75 meter channel or a 20 meter channel! A repeater trustee with an Extra Class license would enable the repeater to use the choicest parts of these low bands in that case.

Once the FCC goes out from under the backlog of comments on recent dockets they plan to get to work on the repeater rules. Hopefully we will see something on this by fall.

Comments on Phone Band Expansion

When we remember the furor created by the original "incentive licensing" proposals, the latest phone band expansion proposals was hardly noticed. The latest count, with the deadline for comments two weeks past, was about 100. Is this a massive agreement with the band expansion or massive apathy? It certainly is massive something.

European Trip

Remembering the fun that we had on the last 73 Tour of Europe, I've tried, now and then, to organize another. Each time, just as things look magazine at about 25% the actual cost of the magazine. Why not reward them by giving their products very serious consideration when buying. All other things being about equal, who not give the nod to a 73 advertiser at buy time?

3. If you write to advertisers make it a point to mention that you have been reading their ads in 73. If they haven't been advertising you might mention that you haven't seen their ads because you read only 73. Well, you don't have to actually lie, but you could exaggerate a little?

When you visit a distributor let him know that you read 73 and are anxious to have him support 73 and for him to encourage manufacturers to support 73.

If manufacturers realized how seriously they were cutting into their sales by not advertising in 73, they would all be with us every month. But they are confused by wild circulation claims of other publishers, sworn to on a stack of bibles of all faiths. They are impressed by old age, reactionary policies, non-controversial editorials and cut rate ads (which mean that *you* get fewer pages of articles).

Ads in 73 *do* sell. We carefully thread them through the magazine to make sure that every reader *sees* every ad. Whether they are read or not is up to the advertiser and his ingenuity. We can't *make* the products sell, of course, all we can do is make sure that the ads are seen.

If only ten of the advertisers running full page ads in one or more of the other ham magazines were to include 73 in their regular advertising schedule you would have a big fat magazine to read every month. Just ten of the following full page advertisers could swing the difference if they were regularly in 73: Eimac, Spectronics, Harrison, Robot, Trigger, Hy-Gain, Galaxy, Ten-Tec, World Radio, Ehrhorn, Allied-Radio Shack, Gotham, Hallicrafters, Collins, Amateur Electronic Supply, RCA, Savoy, Rohn, Sams, Electro-Voice, Heath, Newtronics, Kirk, Ham Buerger, Arrow, Amrad, Avanti, Hal, Barry, R&R. It wouldn't take very many of those multi-page ad spreads by Swan, Hy-Gain, Heath, Spectronics, etc., for us to be able to give you more articles than you could read.

. . . Wayne

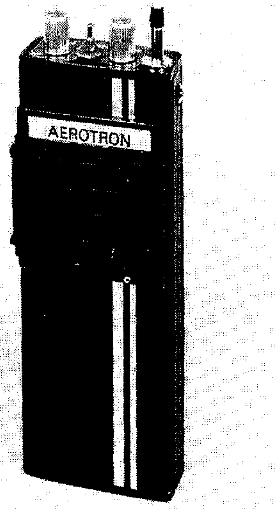
Tell our advertisers your saw it in 73

The second departure is that the mechanical movement has been replaced by tiny integrated circuits. These circuits provide the signals that turn on the appropriate diodes to indicate hours, minutes, and seconds.

The third departure is that the timing device is a quartz crystal instead of a tuning fork or a circular balance staff. A quartz crystal is one of the most accurate frequency generating devices known to technology and is expected to give this time piece unsurpassed accuracy.

The light-emitting diodes are small pieces of special solid material (gallium arsenide phosphide) that glow bright red when a voltage is applied to them. They contain no filament or gas as do more conventional light sources, but actually convert a direct current (dc) into red light.

Although currently only in the research phase, it is almost certain that the electronics inside will be commercially adopted not only in clocks but wrist watches as well. It is expected that a full integrated form of the clock circuit will exist within the year for application in clocks. Further work is being done to increase the efficiency of the light-emitting diodes so that the small battery of a wrist watch will be able to operate it.



of 146 to 174 MHz. Test jacks make possible all important measurements: RF power output, deviation, frequency, receiver sensitivity, audio output and distortion . . . without the need to open the case. The "600" series features "crystal lattice filtering." The transmitter section is available in power output levels of 100 mW, 1.8W and 50W. Options include continuous tone squelch and up to 6 channels capability. *AEROTRON, INC., P.O. Box 6527, Raleigh NC 17608.*

SOLID ELECTROLYTE ALUMINUM FOIL CAPACITORS

Amperex Electronic Corporation, a subsidiary of North American Philips Corporation, has announced the development of a new line of solid electrolyte aluminum foil capacitors. Designated Series 121, these new devices fill the gap between dry aluminum and solid tantalum electrolytics for circuitry requiring long life, high reliability and stability over a wide range of temperatures. With electrical characteristics similar to solid tantalum types, the new Series 121 capacitors

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LEAKY LINES

David Mann K2AGZ

This is the first time in about three months that I've been able to devote to writing an installment of Leaky Lines, since there has been an extraordinary spate of activity in another phase and another direction. A friend of mine who works for a TV network and I were discussing the horrid and putrid state of television nowadays during a late night 15 meter QSO, and we decided that we might put our heads together and try to come up with some ideas for TV production. We reasoned that it wasn't enough merely to sit on the sidelines and carp about what was lousy in television – that we ought to try to come up with something better. Otherwise we would be the same as the present-day critics of our society who gripe, complain, and tear down everything in sight without proposing something better with which to replace it. Fortunately our efforts appear to be bearing some fruit, and we just might get lucky enough to capitalize on the venture. Never let it be said that I am averse to making money . . . unlike others who feign disinterest, I am very much in favor of large, copious gobs of the stuff, having discovered many, many years ago that it comes in quite handy, especially if you want to keep eating, wearing shoes, buying little goodies for the ham shack, and so forth.

So my friend and I have been rather busy promoting some ideas, and things look promising. If anything catches fire, or begins to jell, there is a strong possibility that we can cash in handsomely.

That, briefly, is the reason I have not been turning out any copy for this space. I gather that in some quarters it has not been missed very much. But there have been some expressions of disturbed by this apparent shift toward FM, away from what is commonly regarded as the prime ham spectrum, 10 through 80 meters. They seem to feel that this area of interest is of little or no importance. I must confess that I too, felt similar qualms when the emphasis on FM began to nudge for attention in the pages of 73. I had the feeling that large segments of the readership were going to begin feeling alienated – that they might not renew their subscriptions – and that this would lead inevitably to a loss of advertisers, who are interested in reaching the largest number of potential buyers, which in most cases meant buyers of HF gear . . . not FM equipment. But little did any of us reckon with the realities of the situation. The fallacy of our thinking is now perfectly evident, for the manufacturers of FM equipment are enjoying high sales volume, and continued growth of repeater activity shows every sign that it is a permanent and major part of amateur radio.

The expressions of reluctance to become involved in VHF-FM on the part of many HF operators is quite reminiscent of the early resistance to single sideband openly expressed by devotees of AM during the period when SSB was becoming *the* voice mode, back about ten years ago. I can recall vividly that sideband signals were characterized by phrases such as silly sideband, stupid sap-band, Donald Duck, quack-quack, suppressed character, and other unflattering terms. But in the long run it became impossible for all but a few diehards, zealots and fanatics to disregard its obvious advantages over AM. And while there are still some AM stations to be heard on the bands today, their numbers are exceedingly small, especially on the prime DX bands. The advent of moderately priced sideband gear in kit form really sounded the final death knell of AM. It was inexpensive, compact, lightweight, very satisfactory in performance, easily maintained and serviced for the most what prompts it. Look at it this way. The use of two meters prior to the current development was limited to specific areas. Round tables within severely circumscribed geographic regions, occasional coastal, tropospheric and meteor shower openings which permitted some limited DX work, experimental operations with moonbounce and some satellite action, a few brave souls trying some RTTY communications, club station activities, some design and construction, some mobile activity, AREC, RACES and MARS, a smattering of CW, and virtually a minimum of SSB activity. But, all things considered, outside of short-range communications, it was a tremendous waste of a huge resource. Just consider the size of that band . . . four megacycles (I just cannot get used to that other term!). That's more than all the HF bands put together and, if properly utilized, could relieve HF bands of a great deal of overcrowding and QRM.

Repeaters have accomplished a tremendous service in this connection. They have obviated the necessity for mobiles, for instance, to try to compete with kilowatt stations on crowded DX bands. They have supplied useful and serviceable channels for communication when other channels have been unusable. They have extended the range of normal operation tremendously. They have added another tool to the amateurs' bag of tricks. They make proper use of a large segment of our allotted spectrum, thus guarding against possible loss through disuse.

These are some of the pluses. How about the minuses?

Frankly, once the illogical objections are dealt with, it is difficult to find any minuses. When people begin voicing baseless prejudices as though they were valid, it does not pay to answer them. If someone actually feels honestly that 2 meter FM operation resembles CB, it is simply useless to try to convince him otherwise, for the very idea of this is downright silly. ing with respect to the ARRL recommendation. But I am vitally concerned about the setting aside of a regulation, simply because it might be considered inconvenient or unfair to one group or another. Granted, the proposal does concern a slice of spectrum, redistribution of which might work to the disadvantage of our northern neighbors. But just consider the fact that the total number of hams in the entire Dominion of Canada is not equal to the ham population of New Jersey, or about three percent of the total U.S. ham fraternity. We are then faced with the possibility that a tiny minority could thwart the needs and desires of an overwhelming majority!

In my judgment it would have been perfectly proper for Director Eaton to be permitted to express his views and try to persuade others to cast their votes according to how well he had succeeded in convincing them. But I think it highly improper and even dangerous to set the rules aside in order to allow him an actual vote. Since Canadian interest in this matter amounts to a special interest, and since they presently enjoy phone privileges far in excess of our own, it seems rather ungracious of them to insist upon exclusivity of operation in the foreign portions. And for them to have the right to vote upon the question does not sit very well with me.

I think the Canadian Director would have been well advised to merely express his views, then to disqualify himself from voting, even when the League Council saw fit to set aside the regulation, permitting him to vote.

Perhaps the FCC proposal will indeed lead to American interference with foreign stations, as the Canadians fear. It may lead to some trouble. No one really knows for sure. But I still cannot see any wisdom in permitting those who are specifically disqualified to cast votes in determining the issue. It is a dangerous precedent which could lead to terribly undesirable results.

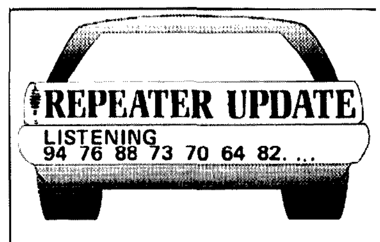
* * *

I've recently rediscovered the joys of flea power CW operation, using a tiny little rig described by W7OE in an article which appeared a couple of years ago.* This particular transmitter utilizes the small oscillator kits manufactured by International Crystal. It is a band switching affair, 15 through 80 meters. Just to show you what can be done with minute power . . . on 40 meters I hooked up with and worked 27 states and 11 DX countries in two weekend sessions. Of course my 40 meter beam must have helped somewhat, but I'm sure it was not the sole factor.

While it is possible to overdo the thing and become an impossible purist in this QRP business, it is highly satisfying to run reasonably low power and make contact after contact, with good signal reports. I have been running around 1.2W, using a 6V dc supply, and up to 1.7W, using 9V dc. Current drain on battery supplies leave something to be desired, so it would be well to construct small regulated power supplies, and some nice ones are available from Radio Shack, Lafayette or Heathkit which serve very nicely.

I recommend this venture to anyone who feels a sense of purposelessness or whose tastes have become jaded because of the same old operating rut. There are many circuits available, and if you are particularly smitten with the idea, why not roll your own, using contemporary solid state devices. I can promise that you will experience pleasures that will more than repay you for the small effort involved.

. . .K2AGZ



disappointment relayed to me through on-the-air contact, and for those, I am grateful.

During this period I have been able to get on the air with greater frequency, and have spoken with hundreds of fellows who have seemed eager to talk about 73, which surprised me much, because I had very little inkling that so many were familiar with this column. Most of these hams were either anxious to argue about points which had been raised from time to time in the column, or to take issue with what they regard as opposition to ARRL . . . either from me or from Wayne. I had a good deal of trouble trying to make these people understand that disagreements with the programs of the League do not necessarily imply opposition. In fact, they sometimes demonstrate a greater desire to help than to hinder. But we need not examine that question, for it has been hashed over so many times it has whiskers. Suffice it to say that there are hams who feel that nobody should "make waves," and as far as I am personally concerned, it's a waste of breath to try to reason with them.

One of the most persistent topics is Wayne's apparent willingness to ease himself out of activity and turn 73 over to a successor. In the May issue, for the first time, he goes into some detail concerning this, and I must confess that it is a big surprise to me. This presents a golden opportunity to someone, not merely because of the soundness of the investment, but because the magazine is in a healthy condition with respect to its relative position among other magazines in the field. It is preeminent in the VHF-FM sector, having begun coverage of this important phase of the hobby long before any of the others. This is undoubtedly due to the guidance of K6MVH, who came to 73 with a superlative advantage of long concentration on FM.

Upon looking over the correspondence section of the last few issues, however, it is apparent that many are part, and most important of all, satisfied the hams' desire to upgrade into modern components and techniques. The older mode remained more or less locked into the techniques and materials of the past. Most hams are mindful of traditional values, and like to preserve them, but when it comes to equipment, they like to be up to date, if possible.

The most damming thing about AM, especially in the face of increased numbers of phone operators, was the excessively broad space required. It simply did not permit optimum use of our frequencies. Let's face it . . . six or more SSB QSO's can take place in the space required by one AM contact. If for no other reason, it had to be replaced.

Many hams deprecate the current trend toward FM, alleging that it is similar to the business band or CB. This is not accurate, and shows a total lack of familiarity with the subject. No one who hasn't listened attentively to repeater operation should express this view, for it is just plain nonsense. One doesn't judge football on the basis of golf, nor express opinions about food on the basis of drama, nor assess portrait painting using criteria related to mining or agriculture. Yet, many are judging FM within a frame of reference which applies to other types of radio communications. Why make judgments of VHF repeater operations based on HF bands?

This is axiomatic; every time some new development phase occurs, there are grumblings of discontent from traditionalists. Just as the stableman and the blacksmith opposed the advent of the combustion engine auto, and the ignorant masses feared being vaccinated against smallpox, so the old guard always objects to each innovation. As the old farmer is supposed to have observed . . . "Yup! I've seen many changes through the years . . . and I've been agin every one of 'em."

While most of us disagree with this grousing, we can certainly understand

On a cost basis this mode is a godsend to both hams and manufacturers. There is a veritable bonanza to be found in surplus equipment which can be modified into serviceable state with very little work. The new equipment is representative of a broad price range, well within the budget of the economy-minded, yet offering more sophisticated, higher priced gear for those who can afford it.

All in all, I think you've got to say that the mode has already gone far beyond experiment status and is a viable and valid part of the ham radio scene . . . perhaps one of its most important parts. So – like other developments which have met with opposition before winning general acceptance – this one will come through also. Any advancement, whether or not it meets with the approval of the inertia-bound, will establish itself, for that is the nature of progress. It is irresistible.

* * *

The beginnings of a small brouhaha are fermenting, if indications are not being misinterpreted.

When the ARRL directors held their meeting in May, primarily to take up the question of the FCC proposals concerning redistribution of the phone bands, it had been assumed that they would have to consider the impact of such changes on the Canadian amateurs. After all, there are VE members of the League who deserve consideration and representation, and they have it in the person of Director Noel Eaton.

There is a specific provision in the regulations of ARRL, however, which states, more or less, that in matters relating to frequency allocations for the U.S., the Canadian Director's vote shall not be counted. Since this particular question directly affects the Canadians, however, Mr. Eaton is said to have made a strong pitch for being permitted to vote. And evidently the League Council concurred, because the vote was indeed cast and counted.

Now, I am not concerned in the slightest with the results of the meet-

* * *

Once again I feel it necessary to call attention to what has become a damnable nuisance on the lower part of the 20 meter band. Despite letters from some of the KP4's and others, seeking to justify the condition on various grounds, or to minimize its importance, the constant use of our best DX frequencies for phone patch activity has become a thorn in the sides of many DX'ers whose interests are being flouted. I want to make it absolutely clear that I do not object to phone patching, in and of itself. If stations want to accommodate people with this type of service, all well and good. But why in the world must they insist upon using our prime DX frequencies? They can just as easily use other channels without annoying anyone. But no! They insist on getting into the juicy part of the band. Reminds me of a pig in clover.

The other night I counted six of them, between 14.200 and 14.210, and the screaming, FM'ing, caterwauling and overmodulation was horrendous. It seems to me that frequencies might be found that would be a lot more suitable for this activity, and that everyone would profit thereby, including the very stations who wish to participate in it.

One brief cautionary word. Stations running patches are responsible for all transmissions on their equipment. If a patch is being conducted in a foreign tongue with which an amateur may be unfamiliar, it is possible for him to incur serious violations. Remember, you must maintain control of the transmitter, and if the party on the other end is unaware of the limits with respect to content and language, you may run afoul of the regulations, should he exceed what is permissable. Make perfectly sure, before running any patches in other languages, that your party fully understands his responsibility in avoiding questionable phraseology, and to steer clear of business matters, which are strictly prohibited.

Listed below are recent changes and additions to our comprehensive open repeater directory which appeared in April. All our readers are urged to send in corrections to our directory so that future editions will be accurate.

All frequencies listed are in megahertz with input frequency/output frequency.

There is a new repeater operating in Columbia SC on 146.28/146.88 output. Using narrowband gain antennas for receive and transmit and a power output of 35W, they have coverage of about a 40 mile radius. The temporary call being used is WA4MPC.

W4RRW is a new repeater in Smyrna GA (near Atlanta) using 146.28/146.88 output.

W4DOC, Atlanta GA, has a tape recorder logging the first 15 seconds of each repeater key. Users are asked to give time and location (location to aid in evaluation of coverage). On signing off users are requested to let the repeater give its ID and unkey before transmitting your own call and your sign out time. After the last carrier, the timer waits 4 seconds, gives a voice ID and drops out.

WB4PLN, Columbia SC, was incorrectly listed as WB5PLN. WB4PLN is located 18 miles SW of Columbia in Pelion SC. It runs about 100W into an antenna about 165 feet above ground. Transmitter and receiver are about 6 miles apart.

The Council Bluffs IA repeater listed with the temporary call of KØJIU has been issued a permanent call: WAØVVD. Using 146.22/146.82, it covers Omaha NB as well as Council Bluffs IA. It is sponsored by the Council Bluffs Repeater Association.

The Chilliwack (British Columbia) ARC's wideband repeater, VE7ELK, has changed from 147.33/146.58 output to 146.46/147.00.

The Colorado Springs repeater was incorrectly listed as using 146.34/146.94. They actually use 146.16/146.76.

(continued on News Page 6)

CONTESTS

WAEDC

The Deutscher Amateur Radio Club (DARC) has announced the Worked All Europe DX Contest. This is, of course, one of the big contests. Over 5000 amateurs participated in this contest last year, so it certainly ranks as one of the major contests. For this reason we include this summary of the 1971 rules. We suggest, however, that you write to the DARC for complete rules and the WAE countries list.

Time: C. W. August 7–8, Phone September 11–12, Starts 0000 GMT Saturday; Ends 2400 GMT Sunday.

Bands: 3.5 thru 28 MHz

Classifications: Single Operator – All Band; Multi Operator – Single Transmitter.

Rest period(s): The 12 hours rest period for single-Op stations may be taken in three periods.

QSOs: Only between European and non-European stations.

Exchange: RST/RS plus serial number.

Points: Each QSO 1 point, except 3.5 MHz 2 points. Each QTC – given or received – 1 point.

Multipliers: For non-Europeans each WAE-Country. Europeans check to the ARRL countries list + each call area of JA, PY, VE, VO, VK, K/W, UA9/Ø. 80 meter mult. count three, 40 meter mult. two.

Final score: The final score is the number of QSO points plus QTC points multiplied by the total multipliers from all bands.

QTC – traffic: Non-Europeans report their QSOs back to a European station (max. of 10 to same station per band).

QTC contains: Time / CALL / number received.

Logs: Send S.A.S.E. for free log sheets.

Deadline: C.W. September 15th, Phone October 15th.

Mailing address: WAEDC – Committee, D - 895 Kaufbeuren, Postfach 292, GERMANY.

Logs: (a) Must show in this order: date, time in GMT; call sign of station contacted; band; serial number sent; serial number received. *Underline* each new VK/ZL call area contacted and use a different log for each band. (b) Summary Sheet to show: call sign, name and address (in block letters please) and details of equipment used – and, for EACH BAND: QSO points for that band and VK/ZL call areas worked on that band.

"All Band" score will be total QSO points multiplied by the sum of VK/ZL call areas on all bands while "single band" scores will be that band's QSO points multiplied by VK/ZL call areas worked on that band

Sign a declaration that all rules and regulations were observed.

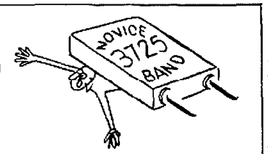
Awards: Especially attractive coloured pictorial certificates will be awarded to each country (call area for W/K, JA, UA) on the following basis –

(1) Top Scorer using "all bands."

(2) Other certificates may be awarded – to be determined by conditions and activity. There are separate awards for phone and CW.

Listeners' Section: To count for points, a VK or a ZL station ONLY must be heard in a QSO and the following details noted in the log – date; time in GMT; call of the VK or ZL station heard; call of the station he is working; RS(T) of the VK/ZL station heard; serial number sent by the VK/ZL station heard; band; points. Scoring is on the same basis as for the transmitting section and the summary sheet should be similarly set out.

· ALL LOGS SHOULD BE POSTED TO REACH – FEDERAL CONTEST COMMITTEE – W.I.A., Box N1002 G.P.O., PERTH, W.A. 6001 ON or BEFORE 30th JANUARY, 1972.



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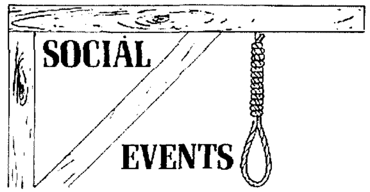


SOCIAL EVENTS

ILLINOIS
SIX METER CLUB OF CHICAGO HAMFEST

The SIX METER CLUB OF CHICAGO, INC., will hold its 14th ANNUAL HAMFEST in Frankfort IL, on Route 45, one mile north of Route 30, on August 1, 1971.

PENNSYLVANIA
MT. AIRY CLUB PICNIC

The Mt. Airy VHF Radio Club, Philadelphia PA, will hold the annual picnic and family day on August 8, 1971 at the Fort Washington State Park in Flourtown PA. More information available from W3FQD, Dick Huntzinger, at 130 Fairhill Drive, Churchville PA 18966.

OHIO
WARREN ARA HAMFEST
AUG. 22, 1971

The Warren ARA will hold their 14th hamfest on Sunday, Aug. 22, 1971 at Yankee Lake on Ohio Rt. 7. There will be picnicing, swimming, prizes, displays, flea market, and a playground. For details and a map send a card to Hamfest, Box 809, Warren OH 44480.

ALABAMA
NORTH ALABAMA HAMFEST

The North Alabama Hamfest Assn. have announced their plans for a hamfest to be held in the cafeteria of John C. Calhoun State Technical and Junior College located north of Decatur on US 31. Write to the NAHA at Box 9, Decatur AL.

NEW MEXICO
NEW MEXICO HAMVENTION 1971

The Amateur Radio Clubs of New Mexico will sponsor the New Mexico HAMVENTION 1971 on September 17, 18 and 19, 1971. Convention headquarters will be the Sheraton

DX FOOTNOTES

The Kuwait/Saudi Arabia Neutral Zone (9K3/8Z5) has been deleted from the DXCC countries list. Only contacts made before Dec. 18, 1969 will count. However, the islands forming the Gabal Group (most well known being Zuquar) in the Red Sea have been approved as a new country. The only station to have operated from there recently is ET3ZU/A. The islands are claimed by Ethiopia but the only activity there has been maintenance crews sent to service the navigational aids on the islands.

More and more strange but legal prefixes are being heard. Included in the list are KD4ITU (QSL via W3ZA), WU3SNA (U.S. Naval Academy, QSL via W3ADO), WM8ICH (QSL via W8HS), and a whole bunch of special ITU suffixes from 9Q5, 9L9, 5T3, and 4U3 lands. KCØKC operated from the Kansas City fair. The Iowa State fair will house a station which has applied for WIØISF or KIØISF. WD6WD will be the call used at the ARRL National Convention in Disneyland from September 1st through 4th.

The *West Coast DX Bulletin* included the following history of one of the world's most tantalizing DX spots: Interest in Rockall . . . like Clipperton and a few others . . . continues to thrive even though any hopes for an early operation are more wistful than factual. The amateurs in OY-Faroes have from time to time given the rock a look over but they are quick to acknowledge that the problems would be formidable and any success would be largely dependent on the weather and sea conditions.

In 1955 the Royal Navy lowered some men onto Rockall from a helicopter to claim the rock in the name of the Queen. At that time a brass plaque was cemented to the top of the rock. It is reported that prior to WW better dust off the key and comb the 20 meter CW band. All JT cards should go to Box 639, Ulan Bator, Mongolia.

If you need some help hooking some of the real rarities like VK9XX, 9M2GV, or 9M8OEA; look for W5ZD between 1300 and 1400 GMT on 14230 kHz. He's always glad to lend a hand.

Even east coast DXers have a good chance to bag a few Indonesian stations by checking into the YB Net on Sundays, 1340 GMT, on 14257 kHz. Incidentally, YB3AAY (Jess at the U.S. Embassy) needs Delaware and Montana for his WAS. Similarly, 9V1OY (Indonesia) hangs around 21035 kHz CW looking for Maine and South Dakota for his WAS.

AC3PT, the only ham in Sikkim (not to mention the only monarch) has been active on 20 SSB recently. Don't hold your breath for a QSL, however.

Don't waste your time working 3V8AL – he's a pirate. Also, 8R1J has been having a hard time with someone using his call. If you have some doubt while working him, ask him his age. The real 8R1J is 45.

If you think missing a rare one is bad, be glad you are not a member of the OH-group who planned the super-DXpedition to Albania (ZA-land). After securing a license to operate, organizing the transportation, equipment, operators, and publicizing the DXpedition so that everybody could work them, the Albanian beaurocracy stopped their plans. Upon arriving in Albania, the OH-group was met, reportedly, by an armed committee, their equipment was impounded, and they were forbidden to operate. Period. The planning, the paperwork, the incredible expense, the thousands of panting DXers were all for nothing, *even though a license and permission had been granted months beforehand.*

Meanwhile, DL7FT had also planned an expedition to ZA-land. In the face of Albanian hostility to ham operating and the OH-group's expensive failure, DL7FT went to Albania

VK/ZL/OCEANIA DX CONTEST

WIA (Wireless Institute of Australia) and NZART (New Zealand Association of Radio Transmitters) invite all amateurs to participate in this year's VK/ZL/Oceania DX Contest.

When? PHONE: 24 hours from 1000 GMT Saturday 2nd October to 1000 GMT Sunday 3rd October. CW: 24 hours from 1000 GMT Saturday 9th October to 1000 GMT Sunday 10th October.

Scoring: (1) For Oceania Stations other than VK/ZL: 2 points for each QSO on a specific band with VK/ZL stations; 1 point for each QSO on a specific band with Oceania stations other than VK/ZL. (2) For Rest of World other than VK/ZL: 2 points for each QSO on a specific band with VK/ZL stations; 1 point for each QSO on a specific band with Oceania stations other than VK/ZL.

Final Score: is derived by multiplying total QSO points by the sum of VK/ZL call areas worked on all bands. Note: The same VK or ZL call area worked on different bands counts as a separate multiplier.

Serial Numbers will consist of five or six figures, made up of the RS(T) report plus three figures which should commence with 001 and increase by one for each successive QSO – 002, 003, etc.

ROCHESTER HAMVENTION

Here are some shots of a few of the fellows who subscribed to 73 Magazine at the Rochester Hamvention last May. If you're not careful at these conventions, you too might appear in 73!

There is a newsletter being put out just for Novices and beginners. Appropriately named THE NOVICE, it is put out by Greg Ginn (WB6ZNM) and appears monthly with news of Novice traffic handling, Novice nets, FCC actions as related to the Notice, contests, awards, letters, product reviews, and dozens of simple but handy construction projects. It is a big job that Greg is trying to do in putting out THE NOVICE and he would like to get more Novices involved in both reading and writing for THE NOVICE. You can get a sample copy to see for yourself by sending a self-addressed stamped envelope (SASE) with 16¢ postage on it to Greg Ginn, 1240 23rd Street, Hermosa Beach CA 90254.

NOVICE VFO?

QSY anywhere in the Novice band? Sound good? Well the Microcomm people have gone and not only designed, but gotten FCC approval for a Novice VFO!

Not actually a VFO (variable frequency oscillator) in the truest sense, the new unit is actually a VXO (variable crystal oscillator) employing two crystals. After a half year of correspondence with the FCC, Microcomm was finally granted typed-acceptance by the FCC. This is a "first" in amateur radio, although it is a standard practice with commercial and CB equipment. It means, simply, that the equipment as designed and manufactured meets the FCC rules concerning frequency stability – but that modification to the equipment is illegal. It would seem that this is a compromise of the ham spirit and ham initiative for the benefit of the flexibility of VFO operation.

In his petition to the FCC, Jim Shaddox (W6BVE), president of Microcomm, mentioned about a dozen reasons why Novices should be allowed to use VFOs. Among the less obvious reasons was spectrum conservation. At present, if your rock is for 3725 kHz and the fellow you're working is on 3730 kHz you are effectively using two channels to communicate. There are two channels being used so that nobody else could use either one of them without running into some QRM from one of you. If you and the fellow you're working could both get on the same frequency (by zerobeating with the VFO) – say 3725 kHz – you have effectively freed one frequency. When you think about this, it is sort of like a Novice band expansion – more QRM free frequencies!

Novices can now have roundtables and nets – QSOs involving more than two stations. Before, unless everyone was lucky enough to have rocks for the same frequency, you would have to retune your receiver to each fellow's different frequency. Now, if you all zerobeat against one station, there is no receiver retuning.

Crystal control for Novices has actually been a throwback to the pre-WW2 era. At that time virtually all hams were crystal controlled on CW. Every CQ would be followed by minutes of tuning up and down the band looking for a reply – necessitating long calls, wasted time, and spectrum waste. When stable VFOs became technically possible and economically practical, crystal control died out almost immediately. It had too many drawbacks; VFOs had too many advantages. This general ham trend away from crystal control immediately following WW2 should stand as a pretty solid argument in favor of VFO operation.

Motor Hotel on East Highway 66, Albuquerque, New Mexico. The program includes Antenna Session, SSB, LASER Communications, DX, QCWA, Traffic, VHF/FM, Ladies' Luncheon & Fashion Show, AREC/RACES, MARS, manufacturers' displays, a banquet, speakers, many prizes, a flea market/swapfest. Talk-in frequencies: 3940 - 7255 - 146.94. Contact N.M. HAMVENTION, Box 14381, Albuquerque NM 87111.

NEW JERSEY SJRA HAMFEST SEPT. 12, 1971

The South Jersey Radio Association has announced plans for their 23rd annual hamfest on Sunday, Sept. 12, 1971 beginning at 11 AM. Talk-in planned for 3.930, 50-3, and 145-3 MHz. For details and directions send an SASE to the SJRA, Box 909, Sicklerville NJ 09081.

II, fishermen from the Faroes have made a landing on the rock from a fishing boat and reported footing a bit slippery because of the thousands of birds claiming the rock as home. While the rock is rather steep, a crevice on one side gives a difficult but not too difficult access to the top. The RAF Radio Club gave Rockall a prolonged study two years ago but finally gave it up as too expensive an undertaking. Some Northern Europe stations have continued to study a possible approach by sea but here again the costs are the big problem to overcome, after that the actual landing would be the big problem. Rockall is possible . . . should there be sufficient financing . . . but any immediate probability is questionable.

An occasional zone 23 station seems to be getting through. UAØYT, JT1AI, JT1KAF, JT1KAA, JT2AB, and JT1AH have all been worked by U.S. stations. UAØYT, however, is your best bet for a QSL. If you want to work a JT (Mongolia) you had with three other DLs and spent three days straightening out the license situation. Finally he did get the go ahead and put ZA2RPS on the air for a few days. OH2BH, OH5SE, DL7FT, and the rest of both groups have justly earned the gratitude and admiration of DXers for their great efforts in trying to give us a ZA contact. Thanks!

Venezuela may not be particularly rare, but few DXers have received a QSL like this one from R.A. Carvajal (4M2BC). This is his special QSL for slow scan TV contacts.

KH6EDY on Kure Island (yes, it does count as a separate country) is being operated by John, who is connected with the Coast Guard Loran Station there. He has had his share of rig problems but should be active around 7295 kHz and 14280 kHz.

Keep your eyes and ears open for a West Indies DXpedition in September with W7VRO and W7EKM.

ZC4CB is willing to make schedules with anyone – particularly 40 and 80 meter skeds for next winter. His QTH is Box 216, Famagusta, Cyprus.

(continued on News Page 6)

THE 1971 ARRL BOARD MEETING

With comments by a former ARRL Director, A. David Middelton W7ZC/W5CA

The annual meeting of the Board was held May 7 and 8 in Hartford. Attendance totaled thirty-seven, including all sixteen directors, nine vice directors and a mixed bag of HQ and other personnel. The Board was in session for sixteen hours and fifty-two minutes.

Prior to each such meeting there is much expectation that "this time something will actually be accomplished" by these elected officials at their once-a-year gathering.

A sage once said, "Hope springs eternal . . . ." This time was no different! The minutes of the 1971 meeting indicate that little has changed. The Board met, discussed and, for the most part, took little positive action on matters of importance to amateur radio.

Some decisions were made but a total of fifteen measures were "referred to committee," a process that can be and usually is the death of a good idea, as they are seldom heard from again.

In the main, the Board was as reactionary as ever, and that is bad news for thinking amateurs who are always desirous that ARRL will some time act in a manner beneficial to the amateur body politic as well as for their membership still left on the rolls.

What follows is a summary of measures brought up and how they fared. I offer comments from a background of over fifty years of active hamming and observation of the ARRL's modus operandi, including four years as a militant director and eighteen months as a member of the HQ staff. I have no inside dope and am not privy to any Board matters except what I read in the minutes, and with suitable "reading between the lines" based on previous study of such records, and having "been there" for four of these sessions.

Items 41 and 43: The "Eye Bank situation" and FCC 19245 was discussed and, in Item 43, it was requested emergency frequencies during major disasters, and that such situations be publicized over W1AW and ARRL OBS.

Item 35: A motion was made that FCC should request authority from Congress to permit FCC to establish interference rejection requirements and apply them to the manufacturers of TV and other home entertainment equipment. This motion was shot down by an amendment *referring* the matter to the General Counsel to file comments on Docket 19183 with reference to adoption of standards, etc.

For some obscure and long prevailing over-biased reason, the ARRL Board and HQ always back off on anything relating to the elimination of TVI and similar problems! Those who recall the early 50s and the terrible HAM vs TVI fight, may remember that it took drastic directorial action to force ARRL to publish the facts about the "Dallas Plan," the weapon that finally broke the back of the TVI problem. That was in 1951. It is now twenty years later, and still ARRL is reluctant to take a stand against this plague to ham radio.

Item 37: An effort made to request FCC to consider a change in the practice of examinations, to permit applicants to take the theory test before the code test (and other matters) was *referred* to a committee by an amendment.

Item 40: The so-called "Grandfather clause" and other matters pertaining to the Extra Class license was debated and then the Board moved to stand pat on their 1969 decision (items 23 and 54, July 1969 QST minutes). See those items for the full details.

Item 72: A motion (*later tabled*) would have moved W1AW frequencies to points in the General Class segments.

The Board and Board Matters

Items 14 and 15: Article 4 (of the $3000 and would limit that committee's actions to implementation of policies established by the Board.

The Executive Committee appears to continually usurp the authority and prerogatives of the Board, but apparently the Directors approve of such procedure, by defeat of this motion.

Item 55: A motion (later *withdrawn* by its instigator) would have had a study made of the organization and operation of HQ.

Such naivete! This director did not know that *any* investigation of HQ is a no-no!

Item 57: Still trying – Director Shima (See Item 55) moved that the General Manager should present to the Board at the annual meeting a three-year operating plan for HQ, outlining his future plans for financial, manpower, publication and membership services and capital expenses. This excellent motion was *referred* to a committee.

Item 58: After years of discussions, Article 7 was amended to read, "Should the office of Vice Director be vacant, the vacancy shall be filled by appointment by the President."

There is no logical explanation why this was not done years ago!

Item 71: HQ was directed to prepare a Special Techniques Handbook – featured sections to include RTTY, ATV, repeaters, Space Comm., facsimile, etc., with a target date of '73.

If the required manpower and funds are made available, and if this is followed through, such a Handbook might be valuable. However, with the state of the art changing so rapidly, devotees of these phases of hamming may better find their data in the pages of ham magazines and up-to-date handbooks published by other groups.

taken on this much-needed investigation of election procedures.

Item 26: Rules 4 and 5 (Constitution and By Laws) (concerning affiliated clubs) were changed and they now require at least 51% of the voting members of a club to be Full or Associate Members of ARRL, and at least 51% of the members of a club be licensed amateurs, etc.

Item 28: This motion grants full membership in ARRL to a person who has held continuous and unlapsed membership in ARRL since May 15, 1934, as well as those already previously covered through license and residency.

Item 33: Director Griggs offered a motion (later *tabled*) that a committee study the feasibility of realigning ARRL divisional boundaries or by weighting the voting power of directors.

Only three directors *opposed* tabling this plan to strengthen ARRL through proper and equable representation.

Item 53: A motion "to take from the table" the realignment motion (Item 33) was *rejected*.

Item 54: In the opinion of one director (Griggs) there should be an annual opinion survey of ARRL members conducted by HQ in QST.

The vote on this poll was one YES, and eleven NO (there are sixteen directors, remember?). Why does the ARRL hierarchy maintain this ridiculous fear of polling its membership?

Item 60: A motion was made to have ARRL publicize in QST, the CQ-magazine sponsored WW DX and WPX contests. This was amended to *refer* this matter to the General Counsel for study. The ARRL has apparently never heard of the act of reciprocity!

Item 59: A motion (later *defeated*) was made to provide one-half page space for each of two directors in each issue of QST, with rotation of the directors to be alphabetical, by division, with the author identified.

AARL Board and Hams At Large

Item 50: The General Counsel was directed to assist, as much as possible, the Counsel of the Chicago Area Radio Club Council, in efforts to establish the right of licensed hams to operate their stations in Chicago.

Item 51: A motion was *passed* that directs HQ to purchase the Dave Bell Association film "THIS IS HAM RADIO" and to make it available to schools and clubs.

This is a new (15 minute) film produced by Bell, W6BVN, at his own initiative following the highly successful reception given his "HAM's WIDE WORLD" film.

Item 89: A committee was directed to make a study to determine the feasibility of again placing QST on sale on newsstands.

The availability of QST among the numerous other hobby-type magazines should publicize ham radio and ARRL. Many potential hams have been denied QST by HQ pique with the newsstand distributors.

The ARRL Board and Public Relations

Item 45: A motion was made (later *referred* to a committee) to establish an advisory committee on PR to foster liaison between the ARRL PR consultant and the hams.

ARRL's PR Consultant is a non-licensed person, but his published work denotes considerable savvy concerning ham radio. All efforts to have HQ provide wider PR seem futile.

* * *

The Board took the usual steps, common to all such meetings, such as resolutions, discussions of pension plans, etc., ad nauseam.

Readers are urged to study the published minutes in July QST, to obtain *all* the information given out on this meeting.

As to *results* of these deliberations, only time will tell.

W7ZC/W5CA■

ARRL vs FCC

Items 9a through 9e: After over three hours of motions, amendments and discussion, ARRL's stand on Docket 19162 emerged with a differing view on voice band expansion from that proposed by FCC. ARRL's proposal is –

3775–4000 kHz for Extra Class (25 kHz *less* than 19162)

3880–4000 kHz for Advanced Class (25 kHz *less* than 19162)

3825–4000 kHz for Cond. and General Class (50 kHz *more* than 19162)

ARRL agreed with 19162 on 40, except that ARRL wants 7075–7100 kHz voice for *all* classes of licenses for Region III possessions *only*.

ARRL disagreed with 19162 on 20 and proposes –

14175–14350 kHz for Extra Class (25 kHz *less* than 19162)

14200–14350 for Advanced Class (25 kHz *less* than 19162)

14275–14350 kHz Cond. and General Class (25 kHz *less* than 19162)

ARRL did not offer a rebuttal on the 15-meter voice expansion.

ARRL opposes *all* of the FCC proposed changes on 10 meters and also opposes the cut from 25 to 10 kHz for the special CW segments.

The foregoing ARRL stand appears to be a compromise between the reactionary and the realistic factions on the Board. The minutes contain no details as to the logic (?) behind their stand, but it adopted after a 14–1 vote. Canadian Director Eaton voted NO, and Director Stricter abstained.

A rhubarb developed when Eaton's voting was challenged. The voting of the Canadian, on what is obviously a matter strictly internal in the U.S., was challenged on two occasions, but both times the Chair (Pres. Denniston) after discussion, with the General Counsel ruled that the Canadian Director *could* vote.

Item 11: The General Manager and Communications Manager were directed to examine the possibilities of strengthening liaison between FCC field offices and ARRL to declare that FCC reconsider its interpretation of Section 97.39 of Rules, and suggested modifications of Rule 97 to guarantee continuation of policies and interpretation of the Rules, pertaining to message handling and other matters.

This "Eye Bank Net" situation should be the subject of an in-depth study, as it has not been fully explained in any ham magazine. FCC's 19245 may have far-reaching effects on amateur radio.

Item 44: A motion that FCC be requested to change classification for Technicians to TECH I and TECH II (Experimenter and Communicator, respectively) was amended to *refer* this to a committee.

Item 56: A motion (later *referred* to a committee) proposed that FCC establish an FCC-Certified Volunteer Examiner program (for persons residing more than 75 miles from an FCC quarterly examining point.

Item 80: A motion requested the General Counsel and the Executive Committee to study the status of the 220 MHz situation and proposals for appropriate action. Why the Executive Committee?

Item 84: A motion to request FCC to reduce the code speed for General and Conditional examinations to 10 wpm was *referred* to a committee.

Item 91: A motion (also *referred* to committee) called for the establishment of 50.050 to 50.1 MHz for Technican and higher class license CW operation.

ARRL HQ Affairs

Item 36: The Board directed that the General Manager identify in his quarterly report the expenditures of ARRL funds for operation of ARRL QSL services, defense of ham frequencies, foreign travel, legal services and the cost of ARRL support to special programs such as the Talcott Mountain Science Center, AMSAT, etc.

Item 39: A motion was *defeated* that would have restricted expenditures by the Executive Committe to Constitution and By Laws) was amended to provide for *two* yearly meetings of the Board, one in January and one in July, to start in '72 – both meetings to be held in the vicinity of ARRL HQ.

This long-overdue change to two meetings a year was opposed by one director, and another abstained from voting on this measure, which, if followed through, will result in better control of ARRL affairs.

Item 20: For the first time, the existence of *former* Directors was recognized when a motion was *passed* to provide copies of all Director's letters (published at HQ) if annually requested by them.

As a member of this large but hitherto ignored "club" I am appreciative of this gesture by the existing officials.

Item 23: A study (by a committee) will be made of Board meeting procedures.

Item 81: A motion was made to revoke authorization for Directors' expenses to ARRL National conventions. This was amended to *refer* it to a committee. Such penurity is noticeable in some Directors!

Item 86: A motion to hold the January '72 meeting in Miami (to coincide with the S.E. Div. Convention) was *rejected*.

How could anyone deliberately choose to travel to Hartford instead of Miami in January!!!! BRRRR!

The Board and ARRL Membership

Item 16: Raising the dues to $7.50 was "moved." but amended to be *referred* to the first '72 meeting of the Board.

Items 22 and 32: A motion made to establish a "Legal Advisory Committee" was *tabled*. This was reinstated in Item 32, the name changed to "Legal Counsel Committee," and *passed*.

Item 24: A motion was made to have a committee *continue* its study of ARRL election procedures.

This "continuance" is a stalling ploy. It prevents any *action* being What better purpose could the pages of QST serve than to have them air the views of the elected representatives. As I was denied access to the pages of QST when a director, I am disgusted with the rejection of this motion. Surely directors must have *some* views on *something* Could it be that they just hate to sign their name to anything and be committed to a stand?

Item 69: A motion, passed ten to six, now permits any member to request mailing of QST via first class mail – if *he* is willing to pay the extra cost.

Item 70: A motion (later *tabled*) would have offered newly licensed Novices membership on a one-year one-time basis for $4.

Item 75: The Board *voted* that the activities of the ARRL Foundation Committee remain in status quo until otherwise directed by the Board.

The delay is inexplicable. What activities?

Item 73: A motion was made that HQ investigate the availability of actual films and tapes showing ham participation in disaster communication for use in documenting the hams' public service. Believe it or not – this harmless little direction was amended and *referred* to a committee!

The Board and VHF

Item 31: A committee was directed to make a study of VHF repeater standards, frequencies and related items.

Item 74: The ARRL Technical Merit Award for 1970 was made jointly to WB6NMT, K2CBA and W7CNK for their efforts resulting in the first 220 MHz EME QSO.

As the originator of this award, I am pleased to see it go to VHF-minded hams once again!

Item 80: The status of the current 220-MHz proposals was referred to the General Counsel and the Executive Committee for study and appropriate action. There's that ubiquitous Executive Committee again!

CARTG RTTY CONTEST

OCT. 16–18

The Canadian Amateur Radio Teletype Group has announced the 11th RTTY DX "British Columbian Centennial" Sweepstakes for the weekend of Oct. 16–18. The rules and scoring are too lengthy to include here, but they can be obtained for a SASE to the CARTG at 85 Fifeshire Rd., Willowdale, Ontario, Canada. The contest looks like a real good one with an emphasis on DX and Canadian QSOs. There is a long list of impressive medallion and plaque awards including special awards for QRP, SWL printer, 10 meter activity, and "Green RTTYer" – anyone who has never participated in a RTTY contest.

TRI-STATE PICNIC SEPT. 19, 1971

The R.I. Swamp Yankee ARC and the Eastern Conn. ARC have announced their Tri-State Picnic for Sept. 19, 1971 beginning at 9:30 AM. Meeting at Pulaski Park, West Gloucester RI, plans call for a trunk equipment sale and picnic. Talk-in will be on 50.35 MHz.

WASHINGTON STATE AWARD

The Puget Sound Council of Amateur Radio Clubs will issue an operating achievement award signed by Governor Daniel J. Evans, for contacts made during Washington State Amateur Radio Week, September 4th to 12th, 1971. Out-of-state amateurs must work ten Washington stations, and in-state amateurs must work twenty other Washington stations during this week. Send list of stations worked, their locations, date of contacts, your name, call and address to: The Puget Sound Council of Amateur Radio Clubs, 12306 80th Avenue East, Puyallup, Washington 98371. An SASE would be appreciated.

REPEATER UPDATE

(continued from News Page 3)

New repeater activity in West Virginia includes W8JDJ on 146.34/146.76. They have a coverage of about a 50 mile radius of Wheeling WV. Atop a 125 foot water tower in Weirton WV is K8ZPR. They cover about a 65 mile radius using 146.34/146.76.

There is a complete revision of our repeater listing for Philadelphia PA. WA3IGS and K3ZTP should be deleted. WA3BKO – the Philadelphia intercity repeater – has been expanded to include operations on 146.22/146.82 (south-east), 146.28/146.88 (north-west), 146.16/146.76 (central), and 146.34/146.94 (west). Also in the Philadelphia area is WA3KUR, listed incorrectly as 52.76/52.525 and 52.76/52.64. They presently operate two repeaters (cross connected) on 52.76/52.64 and 448.8/443.8. There is also an AM repeater, W3QV, on 29.64/29.493.

The repeater listed in our New Jersey listing as "Call unknown (Ford NJ)" has been identified as WA2UWO. This repeater and the separate listing as WA2UWO (still in the NJ listing) are *not open repeaters*. This is quite a repeater with 6 meter, 2 meter, and 450 MHz interconnections along with the use of CTSS. Those interested might write to the NJ FM Asso.c., Box 276, Fords NJ 08863 concerning membership and use.

The repeater listed as WA1KEK, Bridgeport CT, is actually WA1KGK in Trumbull CT. It is tape logged and users are requested to give time at the start of their transmission. Also, its power is 60W out and not the 400W listed. Antenna elevations above sea level are 845 feet for the receiving gain antenna and 720 feet for the transmitting groundplane.

WA2SUR is a super-machine in Manhattan NY previously listed as K1TKJ/2. Transmitting antenna is at 720 feet, and receiving antenna is at

it. I rented a motorcycle as his place is about 9 miles out of town. It was quite a difficult ride out there. I've never driven a cycle over rough roads and I had to pick my way over chuck holes and large stones. It was a beautiful drive. The green of the rice paddies is a green you never see at home. Bare-breasted women doing their wash in the streams. The road choked with people, cows and buffalo. The school itself is set at the very end of the valley – large green hills rise on all sides. There are 300 boys there. I talked with some and they seem to like it very much. After a short wait Father Moran arrived accompanied by 2 other Americans and a British chap. He didn't show any recognition of your call sign or your letter but did remember that you'd helped him talk to his brothers in the past. Since it was about 1 PM Nepal time USA was closed. But you couldn't believe the European contacts he had. Within a space of 20 minutes he worked Russia, Japan, Germany, Italy, England, Spain, Norway, Sweden, Yugoslavia and Jerusalem. He carried on a conversation with us while he was making his contacts. They all talked too long, telling him about their rigs, etc. He tried to keep transmission short. There were so many waiting. He started out with a Russian and when he finished there was so many calling he couldn't hear anyone. So with a mischevious grin on his face he would shout "Everyone up 5KC." That usually spread them out enough so he could pick up someone. Often he just tuned away from the group. Once he picked up a lone Swede calling CQ. The guy was obviously a new ham and quite amazed. Couldn't figure out quite what Moran's QTH was.

He showed us his two favorite cards – one from Ulan Bator, Outer Mongolia and one from Jordan. King Hussein's card is an understatement – very simple – lists his equipment, gives his QTH as "near Amman." He fills in the back himself, as you do.

I'm sorry that I can't remember

NEW PRODUCTS

(continued from News Page 2)

offer higher reliability than either dry aluminum or solid tantalum types.

Unlike solid tantalum or dry aluminum types, Amperex claims their new capacitors can tolerate substantial reverse voltages continuously. For short durations, they can withstand reverse voltage equal to the rated voltage. In addition, the special construction results in high ripple current capability. With no limit on the magnitude of discharge current that can flow, the need for protective series resistance in associated circuits is eliminated.

According to Amperex, reliability tests of 2647 of the new capacitors for a total of over 26 million component hours and 400 million hours of actual field tests demonstrated failure rates lower than 0.1% per 1000 hours of operation at ambient temperatures of 85°C and at maximum operating voltage. Amperex reports that there were zero catastrophic failures in the entire test program.

The electrolyte used in these capacitors is manganese dioxide. Since there is no loss of electrolyte by evaporation at high temperatures, the capacitive element has good long term stability. Because manganese dioxide has very low temperature coefficients, the capacitor is highly stable at operating temperatures between –80°C and +125°C.

Series 121 capacitors are encased in aluminum for mechanical rigidity and insulated with a transparent sleeve. The capacitive element has high humidity tolerance, as shown by the 56-day damp heat test (40°C at 90 to 95% RH) which produced no change in leakage current and a minimal change in capacitance, loss factor and high frequency imepdance.

Series 121 solid electrolyte aluminum foil capacitors are available in six standard case sizes from 2.2 to 330 microfarads and from 6.3 to 40.0 working volts. They are priced competitively with solid tantalum types.

NEW BEAM LEAD OP AMP

With the rapidly expanding use of custom hybrid technology in all types of sub-assemblies for military, medical, industrial and communications equipment, IC chips will find expanding usage. Motorola claims that in applications where system failure cannot be tolerated, the extra reliability of the beam lead system represents a significant improvement of standard IC chips.

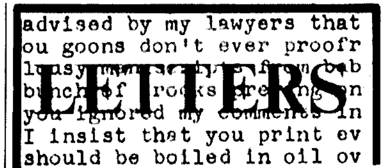
The beams are cantilevered gold structures extending from the chip, which bond readily to a gold-metallized substrate replacing the usual fragile connecting wires and providing one of the most reliable interconnection systems known. The chip is mounted in an inverted position with the beams providing both mechanical mounting and electrical connection.

As an additional step toward total reliability, chip separation is done by an etching process eliminating possible fissures caused by mechanical stresses, involved in other chip separation methods.

The new Motorola MCBC1709 and MCB1709F beam lead devices are electrically identical to the industry standard MC1709 op amp, but their unique mechanical structures spell the difference. Both of these full military temperature range parts are protected by a layer of silicon-nitride passivation which is impervious to device degrading ions.

The MCBC1709 is a beam lead chip suitable for hybrid circuits while the MCB1709F is a beam lead chip housed in a flat package, providing the user, not able to handle IC chips, with reliability advantages of the beam lead concept. *Motorola Inc., Semiconductor Products Division, P.O. Box 20924, Phoenix AZ 85036.*

NEW BOOKS



Cincy Stag Hamfest

The 34th Annual STAG Hamfest will be held on September 26, 1971 at Stricker's Grove, Compton Road, Mt. Healthy, Cincinnati, Ohio. Door prizes each hour, raffle, flea market, model aircraft flying, and contests. $5 cost covers everything. For further details contact:

John H. Bruning W8DSR
6307 Fairhurst Avenue
Cincinnati OH 45213

Omission

How come you do not have us listed under "PREAMPS" on page 50 of the July, 1971 issue of *73 Magazine*?

AEROTRON
Stuart F. Meyer
P.O. Box 6527
Raleigh NC 27608

Stu, it beats me! We know perfectly well that you make a great preamplifier. Put it down to a sudden stroke of ***idiocy, okay?***

. . . Wayne

Are We Really Losing 220

Once in a while a proposal is introduced that needs the support and planning of amateur radio. The proposal in question is RM-1633. This would allow the Citizens Band operator to become an amateur in a way that should induce him to progress in the amateur ranks. Now some of you are going to say that I'm giving away the amateur bands. Not really, because the FCC is the only one who can do this in reality. For the real truth of the matter is that we are on the verge of losing a great deal of spectrum unless we do something about it.

Now the point comes to light that 220 would sound like a madhouse and be completely useless if we let the CBers on the band. I don't think so. I

865 feet. Runs 400W on 146.19/146.73. Coverage includes most of Long Island, southwestern Conn., and north and central NJ.

DX FOOTNOTES

(continued from News Page 4)

There is a strong chance for a Fanning Island DXpedition by WA5DYW (ex-6O1KM). Dates have not come out yet, but keep alert. And while listening around, don't forget Darlene' (VK5DK, WA6FSC, ZL1ATC) on her two year journey through a dozen countries. By now, you should have worked her from Rodriguez. QSL through VR5SK.

If you are looking for Amsterdam Island, look for FB8ZZ, between 14.030 and 14.040 MHz. Real bad pileups tend to frighten him away, but if you do work him you can QSL via F8US.

A reminder about the Arabian Net: check in is at 1900 GMT, Thursdays on 14.295 GMT. A list is made of those checking in and then the list is run through on Saturdays at 1900 GMT on the same frequency.

Last month it was mentioned that Jim (ZM7AG) on Tokelaus was adept at rapid QSYs. It seems that this is the understatement of the century. The *WCDXB* has hinted that many of the W6-land big guns are installing water-cooled VFO bearings just for chasing Jim.

If you are looking for Formosa you won't have to do much tuning around – BV2A is crystal controlled on 14.023 MHz. The only active ham on the island, he is reportedly active around 1200 GMT.

Don't forget the free subscription to 73 for submitting a usable DX station photo to DX Footnotes, 73 Magazine, Peterborough NH 03458.

This letter was written by Terry Jones to his dad Dewitt Jones, W9WKU.

Kathmandu, Nepal
April 3, 1971

Well I've just returned from Father Moran's and I must tell you all about what kind of equipment Moran had. Some transmitter I didn't know very well with a 1000 W linear very much like your small one. Has a 6 element "Hi Gain" Beam at 5,000 ft.

He mentioned that since all his European contacts go over Russia he has to keep on good terms with them.

I left him a message to give you if he worked any W9's. I didn't really feel I could ask him to contact you just for me. Especially since it meant getting up at 6 AM (for him). Besides it cost me $6.00 to rent the bike!

CQ KA CQ KA CQ KA

The Far East Auxiliary Radio League (FEARL) has announced a frequency and time change for the "KA Net." They are now on 14.300 MHz meeting Sundays at 0001 and at 1200 GMT.

FEARL is composed of amateur radio licensees assigned to United States Forces in Japan. The purpose of FEARL, and the "KA Net" which they sponsor, is to promote international goodwill and friendship through the medium of amateur radio.

FEARL offers a series of awards to appeal to the rag chewer, DXer, and SWL. There are awards for working 5, 15, and 25 KA stations and for working all KA call areas. These awards are open to SWLs, too. There are also awards for a 30 minute or an hour QSO with a KA station or a roundtable QSO with at least two KA stations.

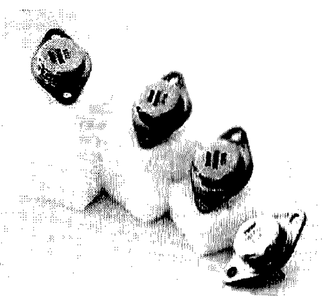
The "KA Net," of course, is a good place to begin working for these awards. The Net, although not a DX or traffic net, does attract a few DX stations. Primarily it is to provide KAs and anybody else with some good rag-chews.

IRISH DXPEDITION

Region One of the Irish Radio Transmitters' Society will hold a DXpedition to Dalkey Island, a small island off the east coast of the Republic of Ireland. The gear will all be run from gas generators. Operating times will be from 1200 GMT 31st July until 1200 GMT 2nd August. CW and SSB will be used on all bands, 3.5 to 30 MHz. The call, EI0DI, will be used. A special QSL card will be sent in confirmation of *all* contacts. QSL address is Box 462, Dublin 9, Ireland.

Amperex Electronic Corporation, Component Division, Hauppage NY 11787.

NEW POWER TRANSISTORS



TRW Capacitor Division has announced a new family of industrial-commercial NPN power transistors featuring high power and high current capabilities. They are intended for use in a wide variety of applications including power switching circuits, audio amplifiers, series and shunt regulators, driver and output series, DC to DC converters, inverters, and solenoid/relay driver service.

The manufacturer claims high power dissipation, excellent secondary breakdown characteristics and very low saturation voltage all combined to give these devices high performance and optimum reliability. The transistor is avilable in a hermetically sealed TO-3 case whose copper base acts as an excellent "built-in" heat sink. Lower power devices are available in a TO-66 case. Prices range from $1.40 to $9.00. *TRW Capacitor Division, Solid State Operation, 112 West First Street, Ogallala NB 69153.*

SPRAGUE CAPACITORS

An expanded and updated edition of a comprehensive *Twist-Lok* and *Print-Lok* Electrolytic Capacitor Replacement Manual has just come off the press, announced the Sprague Products Company.

Expanded to include more set suppliers not found in the previous edition, Manual K-110 covers over 300 different makes including TV sets, home and auto radios, high fidelity equipment, and CB radios manufactured through 1970.

The 40-page manual lists original part numbers for each manufacturer, followed by ratings, recommended Sprague capacitor replacements, and list prices. More than 2500 electrolytic capacitors are listed.

Manual K-110 is available free from Sprague distributors, or may be obtained by writing to *Sprague Products Company, 517 Marshall Street, North Adams MA 02147*.

GENERAL CLASS LICENSE GUIDE

The Study Guide for the General Class License nearing completion in this issue of 73 Magazine has been published in book form by TAB Books. Available in either paperback or gold-embossed hardcover editions, the Amateur Radio General Class License Study Guide was put together by the staff of 73 and designed to provide an understanding of the license exam questions, not just an easy means to memorizing. Judging from the results achieved using 73's Advanced and Extra Class Study Guides, this approach works like a charm. If you have been following the installments in the magazine, here is your chance to get it all together in a handy single volume. If you have your General ticket, this book will be invaluable as a refresher course on theory and practice or as a gift to any deserving Novice. Paperback edition, $4.95. Hardcover, $8.95.. *TAB Books, Blue Ridge Summit PA 17214 and 73 Magazine, Peterborough NH 03458.*

believe that the CBer can do a lot for ham radio. Unfortunately (for ham radio that is) the truth of the matter is that the CBers can, and more than likely do, outshine us in the art of radio communications. The CBer can handle traffic quicker and better than his ham counterpart. This has been proven in the past and will be proven in the future. That is a sad state of facts.

Second; ham radio needs new blood. We have not grown in 10 years! That, my friends, is a fact. I truly and sincerely believe that the use of the 220 band by amateurs and the Hobby-class licensees (CBers) will benefit all concerned. And it will help populate a band that has but a few users.

Also a point that should be brought to light is that the manufacturers of ham equipment will profit by this new proposal, too. I'm sure that everyone is aware that the manufacturers are giving up on ham radio, except in the field of FM transceivers. Now, let's get down to the nitty-gritty. The 220 band is five Megahertz wide. I would like to propose that on a national basis that these subdivisions be used to eliminate confusion.

1. That 220.0 to 220.100 be used for CW only.
2. That 220.100 to 220.500 be used for SSB/AM/CW.
3. That repeaters be allowed in only one portion of the band and that it be from 223.0 to 224.0.
4. And that a sub-band be set aside for controlling repeaters from 224.500 to 225.0.

There is a 20 kHz space between ch. 75 and 225.0 MHz band edge. Channels 1 to 66 are for the hobby class sub-band. Between Channels 42 and 58 is the repeater sub-band. This would be for the use of amateurs and hobby class. Between Channels 67 to 75 would be for the use of repeater control. As stated before, this is to serve to eliminate any mass confusion, and to show the FCC that we as amateurs can control what happens on our bands. *Undoubtedly*, some will say that the existence of TV Ch. 13 will all but eliminate any useful ham

(continued on News Page 7)

(continued from News Page 6)

activity on 220. I see no reason why the amateurs can't share these channels for use in Channel 13 country. It would be basically like 2 meters. A lot of AM boys are on 146.25 which is in the FM region, and to my knowledge they get along fairly well. I see no reason why this would not work on 220. In conclusion, I would like to say that the future of ham radio is on us all, and that we must make decisions that will better ham radio for all of us.

If anyone wishes to write to me, either expressing an opinion for or against this, or if you have any suggestions to improve this proposal, please drop me a line and let me know. I would especially like to hear from the repeater people and the others who use 220. I would sincerely like to hear from all of you. My address is: 16032- 14 Ave S., Seattle WA 98148. Remember; only you can save amateur radio.

Michael D. Payne WØLVJ

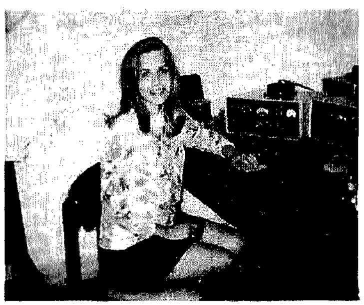
Join the Ranks

Please enter my subscription to 73 for a year. I have let my membership in the ARRL expire, at least temporarily, in protest to "incentive licensing." This is because of my concern for its long term effect on amateur radio, and not sour grapes. I have the Extra class.

Forrest O. Burk W4JFQ
353 Coral Drive
Cape Canaveral FL 32920

Some Have It Made

I remember reading in 73 a few issues back where you wanted the



be a pleasure to newcomers. Also a simple unit, and cheap, might encourage them to try ham radio. One doesn't need a mint to have fun. Nor should one be an engineer to get started. I started my ham ticket in 1938 with a type 76 super regen transceiver on six meters, with loop modulating the antenna power and a carbon mic. with a 21" vertical, and it works.

The fun is partly lost and many potential hams are lost because it is power and big cost units. Small, simple tube and transistor sets, one each month, might attract the potential ham.

Joe Horvath W8QKA
4394 Urban Dr.
Cleveland OH

In the Ham Tradition

Many amateurs have written me obsessed with the fact that the ½ wavelength 80 meter vertical is not a perfect match to 50Ω coax.

Some have suggested the antenna be increased to ¾λ – they failed to read that if the length is increased above 5/8λ, the major radiation lobe decreases in power.

Others have suggested all types of loading coils and matching devices, all introducing reactance to the line – they fail to realize they must readjust their devices every 20 KC on the 80 meter band to keep their magical 50Ω match.

While many have actually "lectured" me, and others merely "suggested" – NONE have made the antenna and tried it!

In keeping with 73's policy of simple, easy-to-construct articles, my article describes a workable 80 meter ½λ vertical that really bounces those S-meters.

After 599, what else is there?

Roland L. Guard, Jr. K4EPI
750 Lily Flagg Road
Huntsville AL 35802

Eureka

Wow! I certainly got an S9 response from my *"New Approach to Metal Locator"*. Most of the writers want to know what can be detected – can you differentiate between tin cans and gold nuggets? . . . etc.

There did seem to be a problem some other magazine. The March 1970 cover "Not-Too-Technical Manual" was a "CLASSIC" . . . compare 66, 67, 68, 69 and part of 70 with your latest ten or twelve issues. Wayne, they're not the same. Hell, your index list used to be a riot.

Hey, this ain't criticism. Amateur Radio obvioulsy needed a magazine dealing with FM exclusively. I guess it's the coming thing.

I never did subscribe to CQ – used to buy it once in a while to take to the john at bus terminals, etc. I keep up my subscription to QST just to keep my League membership alive. And, after the first four issues of Ham Radio, I never even bothered to take them out of their mailing cover. I just let the subscription run out.

If 73 is still the same in 18 months as it is now, I won't renew – not malice – there's just nothing in it (like with Ham Radio) that interests me.

After our talk – some 6 or 7 months ago – I tried to – in fact – I did write three or four articles to submit to you, but I couldn't honestly believe that they'd fit into your new editorial theme. I even tried getting interested in FM so that I could write something funny in and on it – no luck.

It was rather easy to write for 73 when it was a 'fun' magazine. I think that a humorous piece – especially my weird humor would be totally out of place in your new concept and I can't write in and around that new concept.

I've kept my hand in though. I've written and sold a couple of good pieces, but I can't seem to come up with a formula for the new 73. It would be like submitting sections of "Tropic of Capricorn" to the Ladies' Home Journal.

Anyway, that's the explanation. Now, the question . . .

I've tried to keep abreast of magazines that go in for humor articles – even sent off to a Writers handbook to give me a list of magazines, their editors and what they wanted. Not too much available.

Thought perhaps you might have an idea or two floating around in your head. I know you keep up pretty well on all the periodicals. Just off the top

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor. . .

ELIGIBLE VETERANS build and keep a 25-inch Heath solid state color TV as part of a Bell & Howell (DeVry) home study course. GI-Bill pays 100% of the course and kits cost. Contact Bill Welsh (W6DDB), 234 S. Orchard, Burbank CA 91506

WARREN ARA 14TH HAMFEST – Still the friendliest. Sunday, Aug. 22, *new site:* Yankee Lake, on Ohio Rt. 7, five miles north I-80. Picnic, swimming, playground. Prizes, displays, giant free flea market. For Details & map, send card: Hamfest, Box 809, Warren, Ohio 44480.

2 METER FM I.C.E. transistor xcvr. Five xtals, mic, ac dc, FET preamp. Make cash offer or trade. WA5AAO, Box 335, La Grange TX 78945.

SELL: HEATHKIT DX-60 Xmtr $45, HR-10B Rcvr $55, HG-10 VFO $25. All very good condx. Jim Koehler, 4306 Farmcrest, Flint, Mich. 48506.

2-METER FM IC-20, solid state, mint condit, Xtals for .34/.94, .94/.94, .76/.76. Almost new. First check for $220 takes it. Bob Brunkow, 15112 S.E. 44th, Bellevue WA 98004.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland CA 94607. 451-7755, area code 415.

"1971 TESTS-ANSWERS" for FCC First and Second Class License – plus – "Self-Study Ability Test." Proven! $9.95. Satisfaction guaranteed. Command, Box 26348-S, San Francisco 94126.

CANADIANS, Japanese gear, LOW, LOW prices. Free catalogue and information. Glenwood Trading Co., Dept A, 4819 Skyline Dr., North Vancouver, B.C.

NEW SIGNAL-ONE, CX-7, unopened carton, latest model, warranty – sell/trade. Want S/Line, KWM-2, Drake. Don Payne, K4ID, Box 525, Springfield, Tenn., 37172. Nites (615) 384-5643. Days (615) 384-5573.

CINCY STAG HAMFEST: The 34th Annual STAG Hamfest will be held on September 26, 1971 at Stricker's Grove, Compton Road, Mt. Healthy, Cincinnati, Ohio. Door prizes each hour, raffle, lots of food. Flea market, model aircraft flying, and contests. Identify Mr. Hamfest and win prize. $5.00 cost covers everything. For further details, contact, John Bruning – W8DSR, 6307 Fairhurst Avenue, Cincinnati, Ohio 45213.

SAVE MONEY ON PARTS AND TRANSMITTING-RECEIVING TUBES, FOREIGN-DOMESTIC. SEND 25¢ FOR GIANT CATALOG. REFUNDED FIRST ORDER. UNITED RADIO COMPANY, 56-A FERRY STREET, NEWARK, N.J. 07105.

TECH MANUALS – $6.50 each: R-274/FRR, TS-34A/AP, LM-21, BC-779B, BC-639A, TS-186D/UP, ARR-7, BC-348JNQ, SP-600 JX, URM-25D, OS-8C/U, CV-591A/URR, USM-26. S. Consalvo, 4905 Roanne Drive, Washington, DC 20021.

RARE – Jan. 1961 issue of 73; new conx., see page 1, Dec. 1970 issue; also eighth edition (1938) ARRL license manual; good condx. Best offer for each or both. W3WS, 707 Edgemoor Road, Wilmington, Delaware 19809.

hams to send in some photos of the XYL for possible use in your monthly editions. I am enclosing three photos of my XYL, Darlene. Hope you can use them. Although she is not a ham, she is the perfect wife for a ham, hi. She climbs towers, helps me string antennas, haul equipment, etc. As you can see, she also lets me purchase fine ham gear, hi.

Received my World Atlas along with my Life Membership subscription and I think the Atlas is very nice as is the certificate.

Hope to see you on the air again.

Charles C. Thompson K4PHY/TJ1AW
Department of State
Washington DC 10521

Hope to see you both *on the air!*

Electronic Health

I was shocked to read the piece of trash entitled "Electronic Health" in the May 1971 issue. At first I hoped it would be a joke, but it wasn't. The basic problem with articles like this is that there will always be someone who feels he can do a better job of medical treatment than a physician. This would be particularly tragic with the alluded to skin cancer since better than 96% cure of some types can be obtained by such "deliberately old fashioned" methods as chemosurgery, anti-cancer drugs, and laser beams.

Skin cancer, like all cancer, is most likely to be cured if it is treated early. The person who plays with quack gadgets while his chances for cure drop to 0% has been MURDERED just as much by the persons suggesting and publishing an unsound, unproved treatment modality, as by himself.

At this point in time it is too late to unprint the article. I suggest that you publish a warning about the dangers involved and maybe even a list of cancer danger signs, so that there won't be further decreases in the number of U.S. radio amateurs.

Bruce B. Shafiroff WB2FEM/1
College of Medicine - 1971
Burlington VT 05401
University of Vermont

May issue – Electronic Health – let's have a follow-up or a few more articles of this type.

A simple construction article like the 2 meter transistor oftener would with the 4.7 microfarad capacitors. Many wondered whether these capacitors were really that large. Perhaps we should have indicated that they were indeed 4.7 μF solid tantalums and therefore were not physically big. Incidentally, Sprague makes a diverse line of these capacitors and I tell the readers that either the 50 or 100 volt ratings have proved satisfactory. Because we are dealing with a fairly high frequency, I do not recommend other than the solid-state type of capacitor.

Irving M. Gottlieb W6HDM
931 Olive
Menlo Park CA 94025

73 Lives!!

A quick note – for information purposes and to pose a question.

I've finally gotten my ham shack sufficiently arranged, antennas erected, etc., so that I am becoming more and more active on the bands. As I meet more and more of the 'old gang' the inevitable question arises, "How come we don't see you in 73 no more?"

My appearance at a local Allied Radio Shack created an ego inflating stir of giggles and pure belly laughs and, of course, I have been receiving numerous letters asking if I am still writing and, if so, where am I being published.

Although it's impossible for me to coherently explain to you why I haven't contributed anything to you I'll do the best I can.

73 Magazine has undergone a radical change in the past year or so. It's no longer the 'different' magazine – except for the 'letters' column I haven't found a funny line or a cartoon in 73 for a donkey's age.

73 used to be a vibrant, radical even nutty magazine – a break from the monotony of QST and CQ. As it stands now, QST deals with League crap, discount CQ 'cause it's nowhere, Ham Radio is good only if you intend to spend your entire waking hours building useless and semi-useless electronic items that you can buy for half the price at your neighborhood Woolworths.

73 is now the FM magazine. The spontaniety is gone.

For example, your cover used to be worth waiting for, i.e. the takeoffs on of your head, do you know of any that would be interested in my type of humor? Appreciate any advice – really!

Robert A. Manning K1YSD
915 Washington Rd.
P.O. Box 66
West Rye NH 02891

Though it may irritate the Ham Radio readers among our subscribers, I think that you can expect a return to the less reverent days of 73. Please let me have first refusal on your wacky stories. . . .Wayne

Rotten Apples

I saw a few words from my last note to you in the latest issue of 73. I realize that it was handwritten and I never got above a C in penmanship, but you really would make my ancestors create underground waves. Firstly, I have been enjoying FM since 73 turned me on to it (I just got my touchtone pad working today); Secondly, my last name is Falkof – not 'Falhof,'; and Thirdly, and most important, my call is K1NUN, not RVR. Incidentally, I was elected as president of the MIddlesex ARC recently.

Also, Wayne, an important matter arose recently on 40 meters that I need to know a set of procedure: I was handling some traffic in the form of phone patches from a maritime mobile that was limping back to port on one boiler after the other one failed in mid-Atlantic. There was less than the usual amount of QRM until a group of high power addicts moved in 1.5 kc up. This would have been fine, except that the ringleader (explanation below) would not acknowledge myself breaking, nor the /mm. When finally they did recognize us, the leader said, "We're not acknowledging any breakers unless we ask for them so all of you cut there, save your breath." I then explained that I and a station in Maine were handling traffic from a disabled ship at sea and was told that they were on that frequency all night and we could take our traffic and shove it.

Being somewhat reasonable, I asked if, instead of QSYing, they could reduce power. The leader commented to his friends, "Blowing more front ends." Needless to say, contact was never resumed.

Now I know a lot has been written about this type of conduct, and like the weather, no one does anything about it. I would like to write to the FCC to enter a complaint about these five people. I have contacted the ship's operator and a request to contact the ship's captain (who was present while several patches were run, several for him) and I am presently awaiting their word and advice. I wonder what can be done, and what should be done. I personally consider disabled ship's traffic more of a priority than signal reports from Montana to Venezuela. I am willing to submit my log to the FCC as evidence of times and frequencies and call letters and comments. Your comments, advice, etc. are welcome.

Looking forward to an answer in letter or print. I don't mind a little unintentional QRM, but to deliberately continue to interfere is, well, too much has been said.

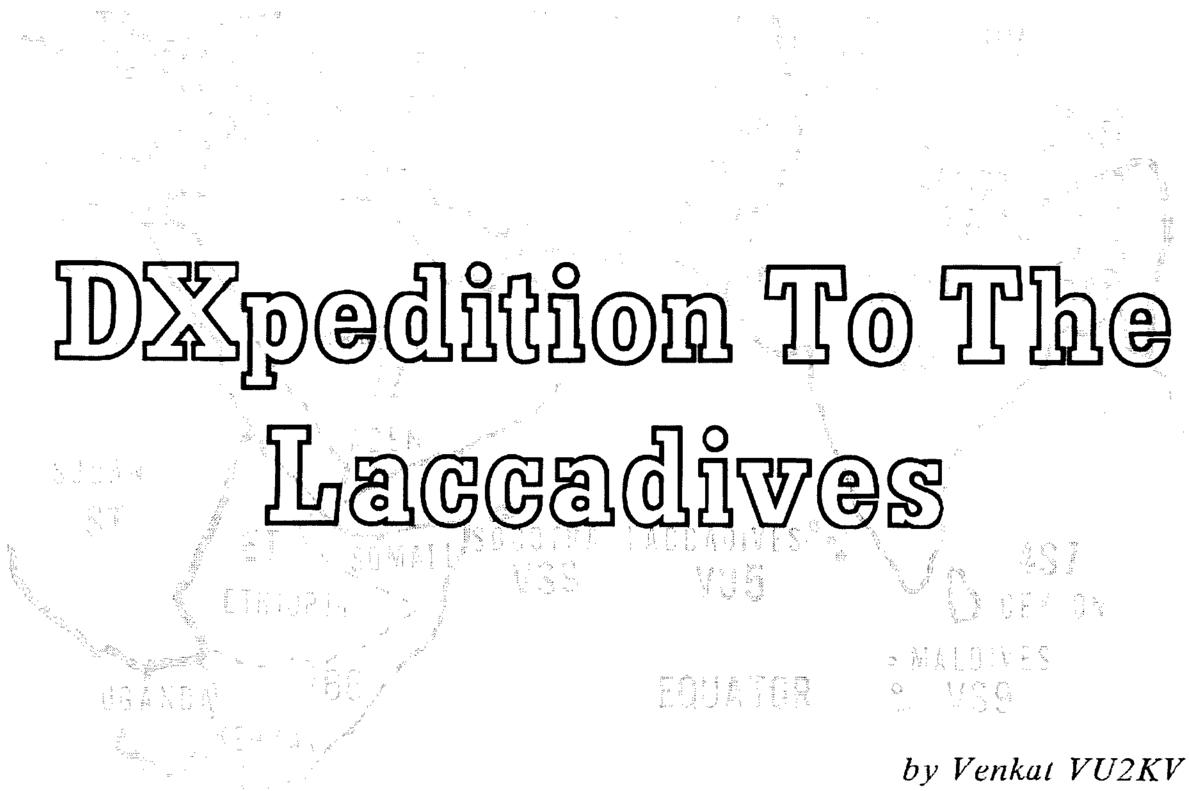
Eric E. Falkof K1NUN
41 Prentice Rd.
Newton MA 02159

Eric, how about passing along the calls involved so I can ask for an explanation? I am sure that our readers will be fascinated to hear the rationalizations for jamming distress traffic. . . .Wayne

Gene Nell (WA4IPZ) has been in a body cast for the past 15 months due to a severe motorcycle accident.

Gene put his Heathkit 2 kW PEP AMP together while lying flat on his back! (And it works, too!)

Ron Watkins K4ZZO
Delta Radio Club, Inc.
P.O. Box 16343
Memphis TN 38116



DXpedition To The Laccadives

by Venkat VU2KV

Every time I go to London I try to see G3BXI so that I can talk with my good friend Dusty W8CQ, who runs the RTTY Journal. Last February I got there just when Jim was signing off with Dusty. I had never dreamt of the Laccadives before and Russ W8DAW, who was also on the net, asked why I did not try to make a visit. Ralph W8PHZ also came on and said the same thing. After the Don Miller story, I did not want to say anything except that I would try and do what I could.

After I got back to India I started to make discreet inquiries about the Laccadive Islands, the climatic conditions there, and the problems of getting permission to operate an amateur radio station. Since my job involves dealing with the government I know how to go about things to get a successful outcome; so I did not put in an application and get a fat NO – that would have been the end of the story. In every country there are places which are restricted for people for one reason or another; and the Laccadives happen to be in this category where the government is forced to restrict entry.

While I was trying to come to grips with the problem, along came Larry K2IXP saying that he was going to the Laccadives. We all knew that at that time it would not have been possible even for Indians to enter without justifiable reason – much less Larry. Larry tried to see everyone at all levels and tried to use his high-level influence, which only made things more difficult for others to get permission. The officials seemed to be fed up with being chased.

It was long after Larry had left that things were ripe enough to put in a formal application for operation from the Laccadives. I asked Rao VU2RM and Hegde VU2DI to come along. Both had been to the Andamans before. They both agreed to take care of their own personal traveling expenses, and I undertook to take care of all the rest. We thought that if people sent us a few extra IRCs we could reasonably hope to recover some of the expenses. Having sorted the composition of the team, the

question was to get sufficient reliable equipment. Having operated a multi-multi station from VU2IRA during the CQ contest, I decided that we should operate in this fashion to take advantage of band openings and also to make more contacts. To do this we needed a lot of equipment. I had the Heathkit HX20 transmitter, the FL1000 amplifier, the Collins 51J4 receiver, and a TA33JR. I got hold of a Swan 500 from VU2DGM and quickly built up a separate vfo for split-frequency operation. I borrowed an FTDX 100 from VU2REG. He did not want to be QRT so we had to get him an FLDX 400 from VU2IRA. Jinny wanted to keep her daily skeds with K6OE so we fixed up a spare HW32 from VU2BEC for her. I also borrowed a 14AVQ from VU2REG/BEO. VU2OMR had a tape dipole and that, with the Heathkit DX40 and SX96, formed the fourth station.

While we were doing all this no one knew about the DXpedition. I was quite regular on the band and everyone was asking about the other expedition which was supposed to go there. Because of the preliminary spadework, the permission came through quickly. There was a hitch about the red tape involved in getting the entry permits, but fortunately the administrator of the Islands who was visiting New Delhi straightened everything out. We were content with the inadequate publicity we'd had thus far, as we did not want to be the cause of idle rumors. We managed to get in print on the Geoff Watts DX Bulletin before the postal strike grounded him and the Gus Browning's DX newssheet before we got to the island. I was also lucky to have QSOs with the DX editors of several clubs during the week before we left, and this also helped to spread the news. The special permission to use the VU5 prefix came very late, so many people were in the dark about the call sign we would be using till they heard us on the air.

Once everything was clear I had to arrange for proper packing of all the gear. I had to plan the packing to insure that each case contained a complete station, and loss or damage to one would still keep us on the air. Packing also meant figuring out the food and probable medical requirements for 20 days, etc. We were aware that nothing was available on the island except fish and coconuts. I also had to take some steel poles for masts because there was nothing suitable on the island. Radha, my wife, also decided to come along just for the fun of it and to insure that in trying to work DX we did not forget to eat. She came prepared with a lot of painting equipment to keep herself busy with the local scenery.

Laccadives is a really DX location for us in New Delhi. It is about 2000 miles away to the south in the Arabian Sea off the west coast of India. There are 20 islands in the "Laccadive, Amindivi, and Minicoy" group, of which only 10 are inhabited. They are all primitive fisherfolk living in these islands who depend on fish and coconuts for their livelihood. The island we went to is Kavaratti, the administrative headquarters for the group.

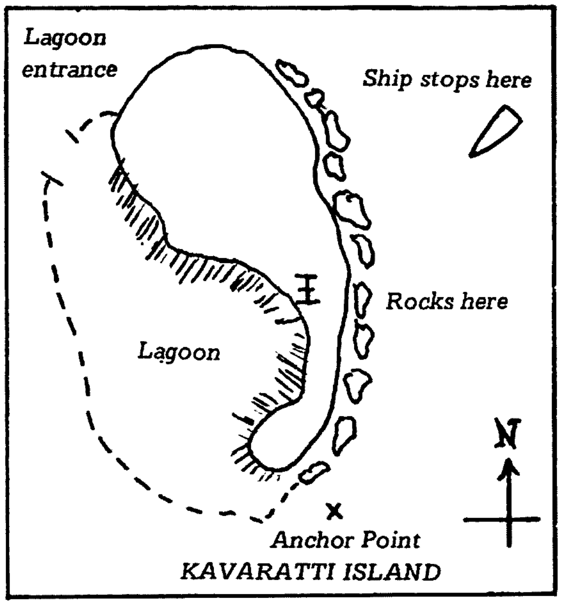
We had to play safe in planning to make sure that there was no last-minute slip. The entire baggage weighed over a half ton, so we had to travel by rail. Because of the long distances involved, we allowed a spare day at each point to avoid missing connections. We left New Delhi for the 1300-mile rail journey to Madras (42 hours). At Madras, Rao joined us. After being entertained by the local hams, we left the next day for the port of Cochin, 500 miles southwest of Madras. We got to Cochin two days

later and were assured that the ship would leave the next afternoon. We were told to get our heavy baggage booked early to avoid delay. It turned out that VU2TH's father worked for the shipping company and that made sure of VIP treatment for the baggage. The extra time we had in Cochin allowed us to pick up fresh vegetables which we would not get in the island.

The shipping service must be highly uneconomical for the company to operate on a reasonable fare structure. To minimize losses they avoid all unnecessary expenses like berthing at the jetty, and instead lay up in mid-channel. The passengers and cargo have to go by small boats to mid-channel and get on the ship there. The captain's 13-year-old son who had come to see his father off was at the winch controls, and for a moment we thought that the antenna package was going to be at the bottom of the shipping channel at Cochin for some underwater DXer. But luck was with us and the boy brought the package through.

Due to radar trouble we set out from Cochin late in the evening and reached Kavaratti island at midday instead of daybreak as planned.

Operation disembark was the trickiest maneuver and can be best described with the help of the sketch of the island and the lagoon. The island has a coral reef forming a lagoon on the western side and the entrance to the lagoon is on the northern end. The ship cannot approach the eastern side of the island because of the steep shelf with large rock outcroppings. The only place where the sea is not too deep for anchoring is near the south tip where it is 200 fathoms deep. Otherwise the sea is about 1000 fathoms within approachable distance. Because there was a lot of cargo to unload, the captain decided to get the



Sand beach on lagoon side, rocks on eastern side. Approximate location of VU5KV shown

ship as close to the lagoon entrance as possible under the conditions. The ship hove to on the leeward side of the island, for there was a moderate breeze blowing from 330 degrees.

We disembarked into a small powered boat on the leeward side of the big ship. Though the waves did not appear large from the deck of the ship, this was tricky and had to be done quickly, as both the ship and the boat were continuously being tossed around. One moment the boat was close to the ship and the next moment it was several feet away. After we had managed to jump into the small boat, things became tougher as the boat was being really tossed hard against the side of the ship and the ladder was being squashed flat.

Having become unsafe, the ladder was retracted and the rest of the passengers had to come down a rope ladder dropped over the ship's side. We were lucky that we did not have to do that. We did not particularly fancy going down a rope ladder with the sea 1000 fathoms deep when we could not be sure of the boat being at the

bottom when we reached there! Also we were lucky that the sea was not really rough as in the monsoon season, when they handle passengers like cargo and lower them into the boat in a rope sling with the ship's winch!

The journey to the lagoon entrance, which was against the breeze, was a slow process as the boat at best of times could not do better than 4 knots. It was not a pleasant journey and we could not take any pictures as every wave sent a huge splash into the boat and we were all completely drenched in the process. The roughest part was the approach to the lagoon entrance. The waves had a complex pattern here and the small boat was really tossed in all directions.

The green color of the lagoon was in sharp contrast to the deep ultramarine blue of the deep sea beyond, and this made a beautiful picture. Navigating through the lagoon was slow as it is very shallow and one could wade through parts of it. After about two hours in the small boat we had our feet firmly on the hot sand.

The island was full of sand all over, and coconut trees provided the only vegetation. It was very cool in the shade but the sand was a furnace. At high tide, the island is 3 miles long, ¾ mile wide at the widest point and only about 50 ft at the narrowest point.

We recovered from the journey after we had filled ourselves with coconut milk. Then we set out on the island's public transport which consists of a tractor with a trailer for the passengers and their baggage. The only other vehicle there is the administrator's jeep. After lunch, we surveyed the scene for possible antenna locations. The place that was allocated to us was too densely overgrown with coconut trees and had the local telegraph wireless station next door working near 7 MHz; so we decided to go to the open space near the police station where they had already cleared some of the trees for their antennas.

The baggage took time to get unloaded and didn't arrive until evening. It was getting dark and we had to act quickly to get on the air the same day. The FTDX 100 was taken out first, and the 14AVQ was fixed on a short piece of pipe driven into the sand.

With so little man-made noise the band was alive with plenty of signals. We made the first contact with VU2BEO at 6:52 p.m., one hour and 22 minutes behind schedule. Then we went off to 14195 kHz and the whole band above 14250 was calling us within ten minutes.

VU2KV sitting, VU2DI standing, white shirt, VU2RM, standing, colored shirt.

We let Rao get familiar with the controls and operate the rig while we unpacked the gear and set everything up. Because of the good packing, nothing was even scratched and we were able to get the linear into operation by about 8 p.m.

It was surprising how much DX we managed to work with 50W dc input into the 14AVQ. We could only work one rig that night as only one antenna

was available, but we used the time to set up and check all the rigs. Hegde unforunately got grounded with tummy trouble and he was marched off to bed after the doctor had given him medicine.

Only after the band showed signs of packing up the next morning were we able to switch off for a while and get the antennas organized. The 14AVQ was repositioned on top of a 20 ft tower and the TA33 was put up. The Mosley vertical was tied up on a flagpole. We had to wait till we could locate a local villager to come to get the tape dipole across two 50 ft coconut trees. With the antennas up we were able to operate two bands at the same time and during the day we were on 15 and 10 meters. As 10 meters went down we would change to 20. We had two rigs on the air practically all the time and three when Hegde was feeling better. Meals had to be staggered to keep the station going.

QRM was tough at all times and the pileups were unprecedented. From the first day onwards, the entire band from 14250 to 14300 was just one wide band of noise. We were later forced to spread the boys across the entire band from 14200 up. Most of the time we never worked anyone on the last worked frequency, and this helped to keep the pileup spread out. The boys seem to have found out how we were changing our listening frequencies, and after the first couple of days the boys were still congregating at some pet spots. So we changed our tactics and kept the boys guessing where we were listening. I guess this gave a chance to the good operators who did not necessarily have high-powered rigs but knew what good operating practice was. We are ourselves surprised how we managed to work three or four stations a minute at peak conditions when QRM was also at the peak.

After excellent conditions for five days the next two days had very poor conditions. On many occasions, though we were putting a good signal into the west coast of the states, there were not takers and we had to get some boys from bed to give us contacts!

Operating from the island had its peculiar problems. The power station had a 36 kW diesel generator. There are no streets in the sand but the paths have lights, and this load is about 40 kW. The line voltage was bad and the regulation hopeless. We were prepared for this contingency and had taken a 15 kVA line voltage adjuster. Even with this the maximum that we were able to boost the line voltage at night was to 210 which would go down to 185 on a whistle. We thought of bucking the line voltage to 110 so that we could use the autotransformer to bring it back to 220 but this meant switching off the mains to change over from day to night, so we decided against it.

At night we had the rigs QRP or work staggered so as not to drop the voltage too low.

We were told that the ship would be sailing for the mainland on January 27th via Amini island. We had no choice but to leave, as the date of the next voyage was indefinite and uncertain. They forced us to get the heavy baggage loaded on the ship on the afternoon of the 26th as the tide was otherwise unfavorable. The low tide the next morning would not permit the heavy boat to get out of the lagoon and they did not want us to hold up the ship while we got our delicate cargo loaded.

We had a great time at the island. We were not too happy at the prospect of

getting the rigs away a day in advance, so we repacked all the stuff and retained the FTDX-100 and the 14AVQ which we could carry in the suitcase with us and the clothes were sent off to the ship. With only one rig available on the 26th we had free time on hand and gave a talk to the local high school on amateur radio. That brought a lot of QRM in the shack that evening.

So we finally bade goodbye to Kavaratti island after having been there for 185 hours from the 19th to the 27th of January and having made 6327 contacts. The sea was very calm and boarding the ship easy. We sailed for Amini island 35 miles northwest of Kavaratti and the ship was anchored outside there for the whole day. We had plans to go ashore and take the FTDX-100 and the 14AVQ and get on the air, but changed our minds at the last moment. Although generally known as the Laccadives, Amini is part of the Amindivi group and we did not want to mar the successsful expedition by operating from there, which could have been questioned. Only Rao ventured to go to the island and came back satisfied after having tasted the local coconuts!

The return journey from Cochin back home was uneventful as we had become very experienced in traveling with luggage in ton lots. Things were even more smooth sailing with the help of VU2MO who helped with train reservations and in insuring VIP treatment for the luggage.

The real part of the DXpedition started when I got back. Little did it occur to me that while it may be possible to make three or four contacts per minute, it is certainly not possible to fill out QSL cards at that rate! When we dropped into the office, I had to get a large sack to cart the mail home. I was on vacation for another week, and that gave me time to catch up with the printers and make sure we had the cards here early and be in a position to tackle the pile soon.

I had a desire to finish the QSL business soon, and if possible within one month of the expedition. So I sat at the dining table till 2 a.m. every day and got the QSLs all answered. We had to make other arrangements for eating, but I was able to get all the cards replied within the target date. Having answered all the cards, I can sit back and take it easy answering the 25–30 cards that are still coming in daily. I only check the cards against the logs and fill them out and thereafter it has been taken care of by the XYL and the two girls aged 8 and 12. They know what the postage rates are, where the addresses are, and all the different commemorative stamps that are available and how to get them. I am sure they will be good QSL managers.

Everything went fine with the DXpedition and we were most happy that nothing went wrong. Murphy did not show up at all and this surprised us a great deal. We realized we were wrong when the film came back from the processors as a blank piece with nothing on it. Closer examination revealed that the camera shutter was stuck shut and all the films were not exposed. The only record of the island that survived are in the pictures Hegde took and the 8 mm color film and this will explain the reason for the few pictures here. We have no way of reproducing the beautiful landscape from the XYL's paintings. At least one lesson has been learned: Checking the rigs is not adequate – *everything* has to be checked before a DXpedition!

. . .VU2KV■

Bob Dean,
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Recording Equipment Co., Inc.

Facsimile for the Radio Amateur Part 1

Many people have been looking into the field of facsimile communications only to find that while it is potentially useful for the radio amateur, there isn't enough literature available dealing with the basics. However, with the data contained herein, the amateur will have the fundamentals with which to explore and conduct facsimile experiments. For instance, you might be interested in direct communications with another ham utilizing facsimile. This method of transmission may be used for practically any type of copy, printed, written, drawn or photographed. Of course while fax will never replace RTTY or voice transmission for traffic handling, the advantages are obvious. For example, remember the last time you tried to explain a complex circuit change over the air? Imagine how easy it would have been if you both had the same schematic. Certainly the U.S. Weather Bureau and Wirephoto services are convinced of its value. Both of these services make continuous use of the facsimile devices for transmitting weather maps and news photos by landline and radio. Since the amount of equipment required to monitor facsimile radio circuits is minimal, it's fairly easy and inexpensive for hams to begin experimenting in this area.

After his first experience with facsimile, the experimenter may be interested in copying APT pictures. These are cloud-cover images received directly from orbiting weather satellites. These cloud-cover photos are used as a forecasting aid. They enable the meteorologists to keep a close watch on uninhabited areas for early detection of potentially dangerous storms.

Hams currently experimenting with slow-scan TV might be interested in knowing that the U. S. Weather Bureau is successfully using ALDEN facsimile recorders as the readout for instantaneous radar weather data. A TV camera operating at 8 scans per second continuously scans a weather radar scope. When connected to an ALDEN remote radar facsimile recorder, highly detailed copy of the radar PPI presentation is produced. Thus, with certain adaptations, the ham that's already experimenting with SSTV might find the facsimile recorder ideal for use as his readout.

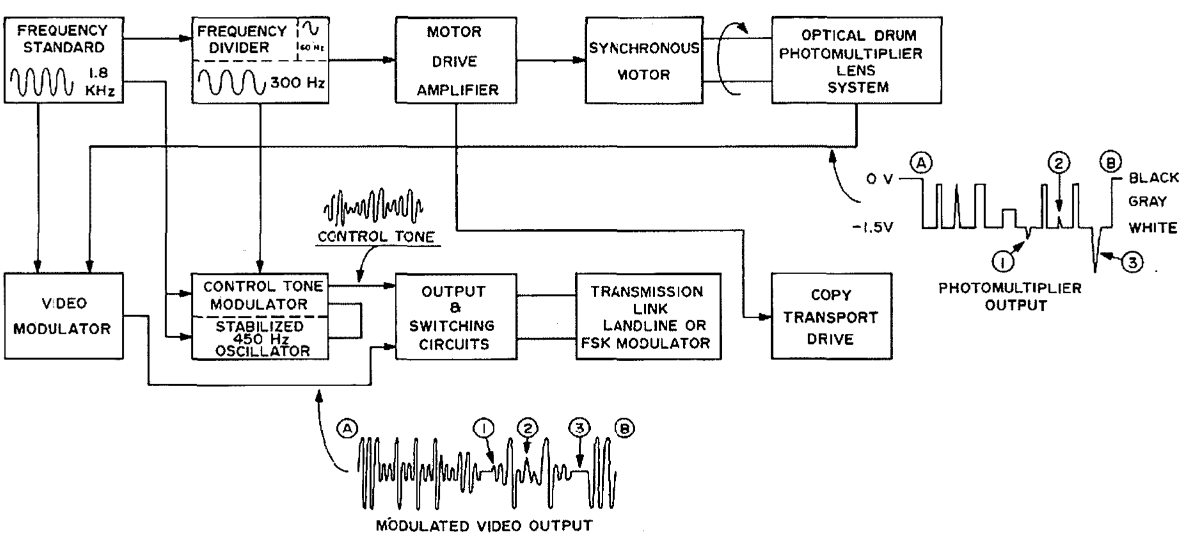
Other uses for the facsimile recorder are

quite varied. For instance, the recording technique is often used as the graphic display for a sonar. A similar device has been attached to a spectrum analyzer and used to provide a graphic record of its output; while still another was used to copy the output of a scanning electron microscope. So you see, even while facsimile's primary use lies in the field of communications it may successfully be adapted to display data from many other sources as well.

Facsimile Operation

Items for transmission are all two-dimensional because the facsimile transmitter is a fixed-focus device with a limited depth of field. There are two widely used methods of sampling the image density of the copy. In one method, the copy is clamped onto a drum facing outwards. The drum revolves at a precisely controlled speed. Light is focused onto the copy in such a manner that the reflected light will be captured by a lens system and passed through an aperture into the photocell. As the drum makes a complete revolution, the photocell samples the intensity of the reflected light for a narrow segment of the copy. As the drum rotates, it also moves longitudinally. In this manner, the image density is sampled one line at a time with the scan beginning on one side of the copy and proceeding completely across it. The second line begins directly beneath the first. The output of the photocell is used to modulate a carrier (usually 2.4 kHz). This may be placed directly on a landline or used as the input of a frequency-shift keyer for transmission using standard sideband equipment.

In the second method copy is fed into the paper feed transport situated above the light table. Reflected light is projected through a lens system forming an image on the straight aperture. An optical glass drum rotates with a transparent helical line scribed in its opaque surface. The intersection of this helical line and the straight aperture forms a flying-spot aperture to scan the image line by line. The light which passes through the aperture is focused onto a photomultiplier which converts the light into an analog electrical signal. The output of the photomultiplier, as in the first unit, is used to modulate a carrier for use on landlines or for use in driving a frequency shift keyer. There are distinct advantages to the second method, such as being able to vary the definition by changing the number of lines scanned per inch of copy. Also, by use of several turret-mounted lenses, optical enlargements of copy can be accomplished. Finally, nearly any thickness copy may be transmitted ranging from onion skin through cardboard. This is not possible on most drum-type transmitters as the copy



wouldn't be in focus.

Included in the fax system block diagram (Fig. 1) is a frequency standard. Normally this will be either a tuning fork or an extremely stable crystal oscillator. The facsimile systems in use throughout the world contain internal standards in both the transmitters and recorders, and all are ultimately referenced to the primary standards. By use of these internal standards the necessity of transmitting a synchronizing pulse along with the video data is eliminated.

One of the major benefits of using all internal standards is that if the signal should be lost for a time due to fade or excessive noise, only the portion of the image scanned during that period is affected. Hence, a recognizable image may often be obtained by way of facsimile when even CW has a hard time coming through. In fact, during severe fade and poor propagation conditions, fax has been used to pass traffic when no other means would work.

As far as the remainder of the block diagram in Fig. 1 is concerned, the primary function is to generate a highly stable 60 Hz output of sufficient amplitude to drive the synchronous motor which precisely controls the rotation of the optical drum. The photomultiplier output is used to modulate the carrier normally 1.8 or 2.4 kHz. The modulated video output or the output of the control tone modulator is then selected and switched to the transmission link.

Two of the wave forms accompanying Fig. 1 depict the output of the photomultiplier and the modulated video. From point A to point B represents one scan line of typical copy. You may note the irregularities numbered 1–3, which are shown primarily to explain the effects you will note on recorded copy. For instance, number 1 shows up as a distinct lack of background noise from the photomultiplier. This is due to an excess of light at that point on the scan, usually caused by a pinhole in the opaque coating in the optics; it is referred to as an "opening." It will show up by eliminating small signal elements of regular copy that occur at that point on the scan.

Number 2 is just the opposite. Here we have a repetitious pulse above the background noise of the photomultiplier. The cause is normally due to dust on the line of the drum or the aperture plate. In this manner, light is partially blocked off at that point in every scan; hence, a straight vertical line will appear in the recorded copy. This is called a "closure."

Number 3 is referred to as the "optical off-time." Here a superwhite pulse is transmitted due to the intentional coincidence of the line on both ends of the drum with the aperture line. Again, this admits an excess of light and in this case negates signal elements that occur during this portion of the scan.

Basic Transmission

Prior to the transmission of an image it is necessary to start the recorder at the reception point and center the image. Depending on the service copied, the sequence of transmission of various control signals will vary. At present, facsimile traffic utilizes a specific sequence of events before and after image transmission.

Weather maps and amateur facsimile transmissions will usually follow the sequence which is depicted in Table I.

Table I. Sequence of Tones, ALDEN Facsimile Recorder

5 sec	5 sec	22–25 sec	1 sec	duration of image	5 sec
240 rpm tone	start	phasing	record tone	image	stop tone

IT'S EASY TO BURN MONEY!

If you're selling to amateurs you are besieged on all sides for your ads . . . the four ham magazines . . . special interest bulletins for FM, VHF, RTTY, traffic, etc. . . . convention programs . . . hamfest programs . . . the list goes on and on . . . a much longer list than your ad budget.

So what do you do? Perhaps you decide to put your eggs in one basket and just advertise in the largest magazine and let it go at that. Or perhaps you figure that you'll do better to advertise in the two largest magazines and not spend the time and trouble trying to get the last dollar of sales out of your ads. If you look at the magazines you notice that some advertisers run ads in all four magazines and ignore problems such as overlap of readership, grossly exaggerated circulation claims, and unfortunately large numbers of non-buying readers.

The prospect of running comparison ads in all the magazines just to try and find out which really does sell the best is frightening . . . and expensive. And then you have to get someone to sit down and count up the dollar volume of sales that the various ads brought in and equate that to the cost of the ads. No wonder so many advertisers just give up and throw the dice to decide their ad placement.

Canny managers realize that the research as to sales effectiveness of the various magazines has already been done for them and by a completely non-biased group . . . the mail order advertisers. This group sells directly to the customer and thus knows exacrly what dollar sales they get from each and every ad placed. They don't waste a lot of money in magazines that don't produce. If you sit down and count the number of mail order advertisers in competing magazines in any field you will have an excellent indication of the effectiveness of the magazines. You will also know how to split your ad budget to get the best sales per dollar spent in advertising.

How are the mail order ads split among the four amateur radio magazines? You can count for yourself but you will find that they are usually as they were in a recent issue . . .

73 . . 70 mail order advertisers
QST . 49 mail order advertisers
HR . 31 mail order advertisers
CQ . . 28 mail order advertisers

Now which of the four magazines do you suppose is doing the best job of selling the ham market?

AD RATES FOR 73 MAGAZINE

	1-5 times	6-11 times	12 times
1 Full Page	$495	$455	$395
1/2 page	270	250	220
1/4 page	135	125	110
1/8 page	70	65	55
1/16 page (1")	35	32	28

Call Aline, at 603-924-3873 and discover how 73 can put a fire under your promotion without burning the old ad dollar.

Table II. Functions for Fax Tones

FREQUENCY	FUNCTION
852 Hz	Selects 240 rpm drum speed in automatic recorders when transmitted prior to the start tone.
675 Hz	Selects 48 lpi paper feed rate, starts recorder – recorder will run at 120 rpm unless preceded by 852 Hz in which case operating speed will be 240 rpm at 48 lpi.
450 Hz	Stops recorder.
300 Hz	Selects 96 lpi paper feed rate, starts recorder. Recorder will run at 120 rpm unless preceded by 852 Hz in which case operating speed will be 240 rpm at 96 loi.
60 Hz	Record tone. Enables paper feed and printing mechanism in some recorders.

During the starting sequence, if the first tone transmitted is 852 Hz, the transmission will be made at a speed of 240 rpm. This is primarily in use on landline circuits. The start tone normally transmitted is 300 Hz. This tone will start most of the recorders which are designed to function automatically. Where receipt of a certain tone selects the paper feed rate, the 300 Hz tone corresponds to 96 lpi. Where the recorder is also capable of automatic drum speed selection, 300 Hz (not preceded by 852 Hz) will initiate recording at 120 rpm. If the start tone should be 675 Hz, this will select 48 lpi resolution at 120 rpm (unless preceded by 852 Hz). Table II is provided as a reference for tone functions.

The next occurrence is the phasing signal (also referred to as the framing bar and/or sync pulse). This is used to center the recording, by insuring the drums of the transmitter and recorder start the scan line at the same instant. The phasing signal is normally solid carrier for 95% of a scan line and a complete collapse for a 5% segment. (The "optical off-time" should be in coincidence with the 5% collapse of carrier.) The duration of the phasing signal is usually 25 seconds.

After the phasing, a 1-sec burst of 60 Hz modulation is transmitted to start certain recorders which have already been framed. This is used in recorders such as the AN/UXH-2. Finally, the video signal (or image data) is transmitted. Normally, a weather map of average size requires about 10 minutes to be completely scanned. After the image is transmitted a stop tone of 450 Hz modulation is sent to shut down the recorder.

Wirephoto Transmissions

Since this service is more or less confidential in nature, the radio broadcast frequencies and transmission times are probably not divulged except to those paying for the service and the FCC. However, it is possible that a ham will eventually locate a working Wirephoto channel. The system of transmission is similar to weather facsimile but I do not believe it is intended to operate completely automatically. The transmission sequence is as follows:

At the beginning of each picture, there are a series of black-to-white transitions varying in number from 3 to about 15. The last white transition which may be preceded by a code line, usually has a duration of approximately 40 sec and is immediately followed by approximately 1 minute of phasing signals. The picture follows immediately. All of the Wirephotos I've copied have been at a speed of 60 rpm; thus, no control tones to change the operating speed would be necessary.

Satellite Transmissions

There are several weather satellites currently in operation and while their transmissions differ slightly, the APT image is a constant. Each frame requires a total of 208 sec to transmit. This figure includes 3 sec of 300 Hz modulation, 5 sec of framing signal and 200 sec (800 scan lines) of image data. (Since most APT recorders start and run upon receipt of the 2.4 kHz carrier the 300 Hz serves only to initiate the framing sequence.)

Radio Sources

Signals are applied to the user in various

ways. The U. S. Weather Bureau, U. S. Navy and Wirephoto services operate extensive landline networks around the country. However, the Weather Bureau and Navy also transmit weather data for use by the ships at sea utilizing HF sideband techniques, and over the last few years they have been experimenting with a satellite in sun synchronous orbit (known as the ATS – Applied Technology Satellite) for relaying. (The ATS operates at 135.6 MHz.) Both weather maps and Wirephotos are transmitted over HF signal paths. The bulk of the signals heard will be FSK. Naturally, this reduces the problems with noise and fading. An 800 Hz shift is generally utilized and the normal frequency limits are 1500 Hz which usually corresponds to black and 2300 Hz which is normally transmitted for white. Gray shades should produce signals which vary linearly from 15 to 2300 Hz with respect to the density of the copy.

Tuning a receiver for facsimile is nearly the same as RTTY. In this case, however, if the bfo happens to be reversed and the correct input limits are obtained you will get an image which is a negative of the original instead of a lot of garble.

The satellites, on the other hand, transmit over a line-of-sight VHF path using 10 kHz deviation FM. In this case we have a very low-noise path due to the use of FM equipment. Thus, the signals from the satellites are strictly 2400 Hz modulation.

To receive these pictures in your shack, you need some type of fax recorder. You could fabricate your own, but I advise against it unless you are a machinist as well as an electronics experimenter. In any event, there is a wide variety of surplus recorders available from military as well as commercial sources. While some modifications and repairs may be necessary you'd come out ahead in the long run.

Next to copy weather maps and Wirephotos you must have some sort of general coverage receiver, which is stable, reasonably sensitive and selective and has the capability for copying sideband. The next part of this article will cover that subject in depth. ■

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YOU CAN TAKE IT WITH YOU!

The fastest growing pastime in America during the past several years has been camping. Families, literally by the millions, have been drawn out of their comfortable homes into the not-so-wild outdoors.

It stands to reason that several thousand of these campers are also hams. It is also well known that many persons believe that hobbies, like certain ingestible liquids, are better when mixed. But mixing ham radio and camping has not been the easiest thing in the world.

Certain problems have made hamming while camping less than simple. In the days when most camping was done in tents and most hamming was done with rack and panel rigs of monstrous proportions, the two just didn't mix. But things are different now in both hobbies. More and more campers are consigning their tents to the attic or basement. They are venturing forth into the bosom of Nature in campers, trailers, motor homes, and the like. At the same time ham gear has become smaller and more genuinely portable. The state of the art in both fields now brings hamming and camping much closer together. Most of the current crop of recreational vehicles lend themselves to the inclusion of radio gear about as well as the average fixed station. A rig like any of the myriad of transceivers on today's market can be included without having to leave something else home.

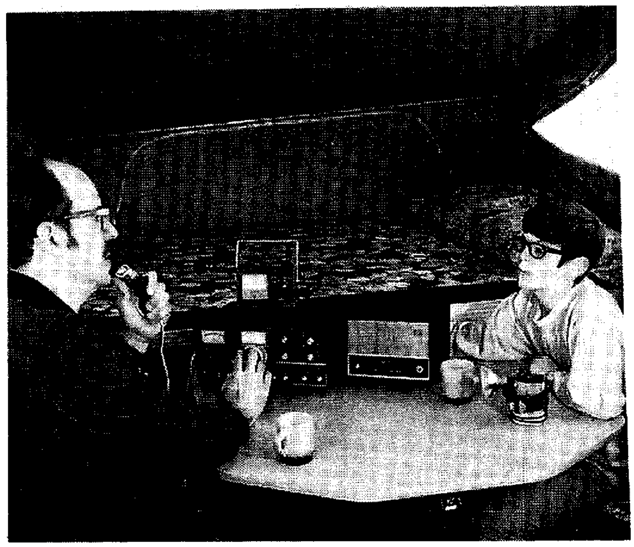
Certain other problems besides space remain to be worked out, but most of them will likewise yield to some degree of determination, with very little sacrifice either in room or operating efficiency.

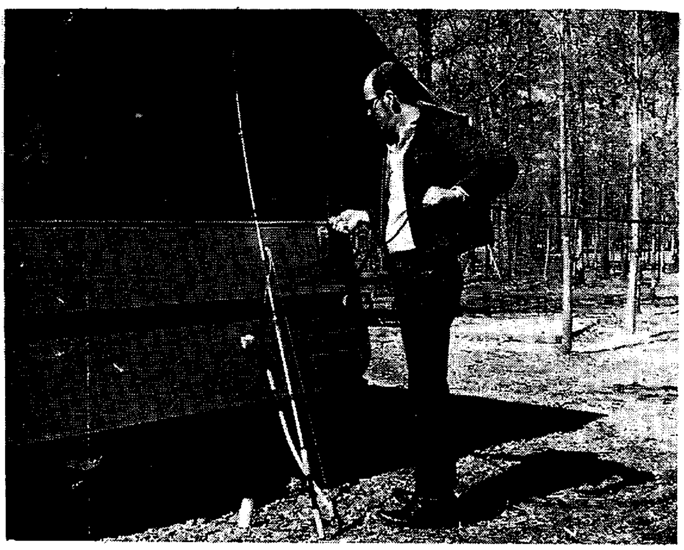
The first and most obvious handicap to be dealt with is an adequate source of power. This was a serious matter when tents were the order of the day. About the only answer then was the already overworked electrical system of the auto itself. This system can handle the added load of ham equipment while the rig is in motion but it is not made to be used in semifixed mode. But this is not much of a problem any more. Almost every type of recreation vehicle (rv) in common use today is wired for ac. All that is necessary now is to pull up to the camping site (after paying the usually very nominal fee) and attach your extension cord to the provided outlet. Very few places will even charge above the minimum when you show them that your equipment is not heavy-current gear.

Most of the camping grounds in America today, both public and privately owned, have installed ac outlets which have reasonably stable sources of power. Very few rv's have breakers or fusestats smaller than 15A, so you are in business!

A somewhat more difficult problem to overcome is the matter of an adequate antenna system. All sorts of systems have been used by enterprising hams but most of them have drawbacks which militate against their use. Some are simple enough to get up but leave a good deal to be desired performance-wise. Others work well but unless you plan to be in one place for several days, it simply is not worthwhile to erect them. The crowded campground presents something of a limitation, too.

But again this problem can be overcome with a system that is both easy to erect and of reasonable efficiency. Over some period





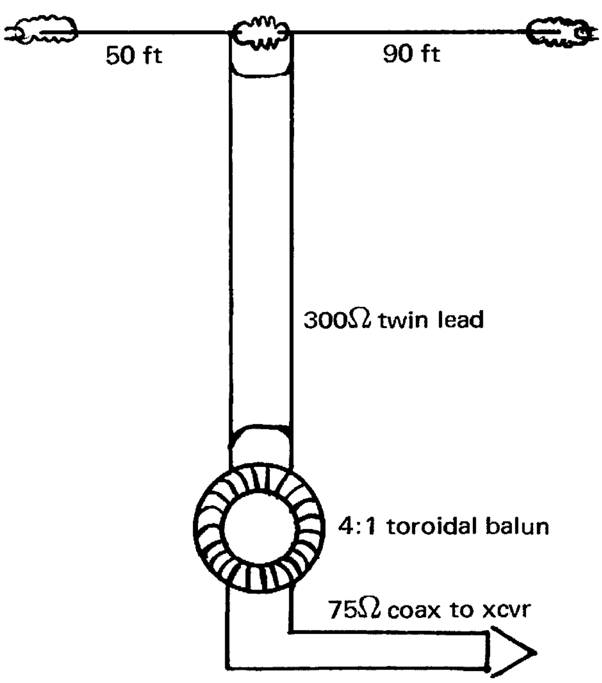


Fig. 1. Sketch of antenna.

of time the author has worked out a system which seems to achieve all that might be asked of such an antenna system. It has been refined during a number of excursions in several parts of the country.

The antenna itself is a 140 ft wire cut in the not unfamiliar mode of the time-honored Windom. This type was chosen for a variety of reasons. First it is multiband, operating quite satisfactorily on 75/80, 40, 20, 10 meters. Second, the antenna is low in cost and easy to construct and takes no special tuning. Third, it is lightweight and can be supported without difficulty by any light support. When fed with 300Ω line and through a simple toroidal balun such an antenna will give low swr on all the above-mentioned bands; and best of all, it represents no compromise on any band. It will compare quite favorably with most fixed station radiators. The details of the antenna are given in Fig. 1.

The only requirement for the erection of a simple wire antenna is a support at each end. Trees are almost universally available in campgrounds. They can easily be used when only a modicum of choice is used in site selection and a simple packet of equipment is stored with the other camping gear.

Basically the process is simplicity itself. No more than 20 minutes should be required to get the wire up and *you* need never get off the ground!

The procedure is as follows:

1. Secure a small bow of the recurved type. This is available virtually anywhere.

The one we use is four feet long and was purchased at a local discount store for less than $5.

2. Select a long arrow and cut a thin notch all around the arrow about five inches from the hackle end.

3. Attach a monofilament line from a fishing rig (the spinning type works well) to the notch.

4. Notch the arrow in the bow, position the rod so that the line will pay off freely, release the catch on the reel, aim above the limb you want the line to go over, and shoot. Practice may not be necessary, but it isn't likely to hurt.)

5. Allow the arrow to go over the selected limb and to fall to the ground below. Some discretion must be used here, obviously, in a crowded area, but we have never found this to present any major problem.

6. Retrieve the arrow and detach the line.

7. Tie a nylon line to the monofilament line. Tie it very carefully with a secure knot.

8. Reel in the line and allow it to be drawn over the limb. Bring it all the way back to you.

9. That's all! Just attach the antenna insulator to the line and hoist up one end. Repeat the process at the other end and you can be on the air with a satisfactory antenna in less time than it has taken you to read this article.

One last word of caution may be in order. You may have found that your recreation vehicle is rough riding. Most of them are. If so, either carry your rig in your car or wrap it securely with some sort of shock absorbing material if you choose to carry it in your trailer.

Such a system will allow you to get your rig installed and on the air almost anywhere, and the best part is that you will be putting out a respectable signal. So the next time the family wants to go camping and the "sweepstakes" is coming up, instead of a contest of will, try a little mixing. You may open up a whole new world of entertainment for yourself by hamming while camping.

...K5PAC■

Diary Of A DXpedition

(For Those Who Can't Afford A DXpedition)

Matt Oreskovic WA2JLF ex-KD2UMP
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Isn't it a shame that the world has lost its sense of humor. Even hobbies have to become avaricious pursuits. And isn't it a shame that life passes you by so quickly that you never get a chance to do a lot of things that you always wanted to do. I know guys who dream of operating their rigs from exotic places, basking in the sun, tossing down cool rum drinks, or checking into a net each day for a prolonged chat with friends on the airwaves until the "Big Net Control" in the sky 73's them for the last go-round. Me, I'm still chasing DX from a cold basement before and after work, fighting it out with the big boys feeding stacked beams up a wavelength, usually getting clobbered. I'll end up in Pooped Payton Place with the best of 'em tending my travel trailer and making TVI for the other trailer park tenants while running traffic north to the kids QTH. So before my SB102, SB640, SB200 get the final tag that says "from the estate of the late WA2JLF" I'd like to be an exotic station, sought after, piled on, cursed and given undeserving complimentary signal reports. I have some buddies that harbor the same dreams. "We'll probably never get to Market Reef or Swan Island." was our cry, until we got our heads together for a poor-man's DXpedition. So this is the true story of a handful of ordinary guys who had a dream come true for twenty-four hours.

It all started the fall of 1970 when a DXpedition to Swan Island occupied the DXers' time. I thought, what the heck, why not have a DXpedition of my own? I discussed it briefly with Zero (WB2ZMO) and Frank (W2RSJ). The next morning driving into town. I talked it over on 2m FM with Joe (K2DSO), an oral surgeon.

I knew of a location with an exotic-sounding name and carrying with it the required difficulties of getting permission to use the place, plus the possibility of getting a call sign that would be distinctive. The location was Squaw Island, located 42 degrees fifty-five minutes 48.5 seconds north latitude, 78 degrees 54 minutes 14.5 seconds west longitude; it lies wholly in American waters between the United States and Canada. The waters west of the island are not navigable except for small powerful craft. Joe (K2DSO) and I had KJ2UNK in mind as a call sign, but the Buffalo FCC office suggested that the call sign would confuse people because of its use on Johnson Island. KD2UMP was chosen, and we are sworn to secrecy as to the originator of the call.

All planning for the DXpedition was taking place on 2m FM, and most listeners thought it was some sort of gag. The Western New York 2m FM bunch is not adverse to pranks such as sending ARRL Official Observer cards to innocent souls for "excessive monitoring." I might add the cards were obsolete, as was the call of the "Official Observer." The counter-

Joe Margarone (K2DSO) (l.) receiving proclamation from Mayor Frank A. Sedita. This was a milestone in the legitimizing of KD2UMP.

attack for the phony cards was planning an imaginary microwave project using helical polarity from left to right – or was it right to left. Bags of opened and used food were to be found on the doorstep of WB2QDA's QTH weekly while he was out on strike. A Canadian user of our repeater, VE3ADO, offered to show me how to put an ac plug on a piece of lamp cord. I might add that he will be the subject of "massive retaliation" when he returns from VK land.

The DXpedition was not a gag, and the deeper we became involved in the project, the more believers joined the ranks. At a meeting of BARRA (Buffalo Amateur Radio Repeater Assocation) Joe (K2DSO) asked for support for the DXpedition. The response was unanimous, as was the response of the South Towns Amateur Radio Society of which I was president. I think the fact that we forgot to ask for money helped railroad the "support resolution" in both clubs. We still had to get a call assigned and a bona fide reason for the DXpedition. The request was drafted and redrafted until it stated the specifics of the desired call, and when the last and final draft was ready for typing we crossed our fingers and hoped that we could get a special call for Squaw Island.

Nearly a month went by and we passed the deadline for any big amateur magazine publicity. The call KD2UMP was finally granted for a twenty-four hour period of time for April 1, 1971, 0000 to 2400 GMT. The real work was just beginning.

I did not know a soul who had been to Squaw Island. and frankly didn't know any legal way of getting to the island to do some necessary scouting. We went ahead with plans anyway. It was immediately evident that several backups for every item necessary would have to be considered. At the appointed hour we could fall back on secondary choices for antennas and rigs, not to mention operators, workers and living accommodations. We now entered the "promise" stage of planning, a time during which souls of good intent tend to promise more than they are capable of delivering. As an example, we were promised – I might add unsolicited – a telegraph pole in excess of forty feet, set in the ground, electric power, and a travel trailer. I don't remember if the "promisee" offered to furnish food and drink for both days or not. Hollow promises tend to waste a lot of time because you have to go through the ritual of calling the promisee until he finally comes to his senses and begs off from the promise.

We would need a tower to support a beam; a ladder that can extend to twenty-five or thirty feet with an eight foot mast would do nicely, and I had such a ladder. We purchased some good nylon line for guying the ladder, and the tower was in the bag. Our South Towns ARC had a beam that was left drooped over a roof after our County Fair episode. A cold winter afternoon liberated the beam and we headed to the clubhouse at a former Nike base to get a 22 amp generator to power the encampment planned for Squaw Island.

Problems began to compound; the generator had a stuck valve and a broken needle valve. Winter claimed a toll on one of the beam traps. My trailer needed some unexpected repair, another trailer had to be taken from winter storage, a

KD2UMP

SQUAW ISLAND DX-PEDITION

QSL card for DXpedition. Bottom row: Lee (WB2QDA), Ted (WA2HKS), Bob (WA2VVF). Standing: Frank (W2RSJ), Matt (WA2JLF), Zero (WB2ZMO), Joe (K2DSO).

third could be had if we could repair a faulty furnace. During this phase, three of us – W2RSJ, Frank, and WB2ZMO – were the only ones doing the physical work connected with repairs and getting the rigs we planned to take along readied. K2DSO was hopping around getting the paperwork taken care of.

Squaw Island has much trivial history attached to it. For example, it was the staging point for an invasion of Canada by a group of Irishmen around the turn of the century. The group were members of the Fenian Society; they crossed over into Canada and occupied a town near the eastern shore for a period of several hours until a contingent of Canadian Provincials routed the party of twelve or so and confiscated their rowboats. During the era of prohibition of the sale of alcoholic beverages in the U.S., smugglers used Squaw Island for a haven. Cottages and boat houses dotted the western shore. After repeal of prohibition, the cottages were taken over by squatters who just recently were forceably evicted by the authorities. So – during the night at least, the island is uninhabited save for wild dogs, wild cats, and rats.

Up to the present time the island has not had a moment of glory. It usually gets a big guffaw from those who know about it. It suffers from gigantic indignity. No one cares about Squaw Island. It is the Orphan of the Antilles, not in the least helped by the fact that Squaw Island (connected to Bird Island by a breakwater and land fill road) is the site of the Buffalo garbage incinerator and sewage treatment plant. There it is, for those of you who suspected, for those of you who knew, and finally those of you who looked into the Atlantic or Pacific waters for the Island of Squaw.

On March 31, 1971, a small band of hams made the trip to Squaw Island to set up the first Amateur Radio Station ever on this desolate piece of land. We found an excellent spot at the last digester tank which was built over land belonging at one time to Squaw Island. Digester tanks function like huge septic tanks. Bacteria work and feed on the waste and liberate gases which are incinerated to burn some of the solids that come from the sewage system.

April first is a bit early for the annual tomato plant sprouting which takes place at the solids dumping ground. Liquids are chemically treated and discharged into adjacent water. The garbage is disposed of in much the same manner of incineration except settling and digesting aren't required, just storage until room is available in the incinerator. An odor familiar, yet unusual, is first noticed when you arrive, but one gets accustomed to it after awhile. Two days and two nights usually do the trick, and it's only after you get home and get a whiff of that old pair of coveralls that memories are brought back.

The erection of the antennas was fast and workmenlike. W2RSJ had a connection with a crew that had access to a cherry picker crane that could be extended to a height of thirty-five feet. This facilitated matters, and we had

everything ready but the living and operator quarters a day before "D Day."

Shortly after the travel trailers were parked and hooked up and the generator purring, we were paid a visit by a guy who could jump center on my basketball team any time. Let's face it, most hams look like refugees from an old Edward G. Robinson movie – I do – and this guy was no different. He greeted me with a bunch of call letters and then proceeded to follow me around like a pet dog. Never having been formally introduced, and having a lot of unattended gear around on the 31st of March, I was concerned about warm bodies roaming in and out of trailers, especially if no one knew who they were. I wondered how the "string bean" got wind of our location, since the local papers only carried a small item about the Mayor of Buffalo proclaiming the first of April as Radio Amateur Recognition Day, and the radio and TV stations had not carried the item because the release was for the next day. I decided to have all strangers not connected with the sanitation and sewage department evicted, and since Lee (WB2QDA) was a southerner and possessed the proper tone and command presence to evict strangers, the duty of ridding our encampment of strangers before Radio Amateur Recognition Day fell upon him. About ten minutes after my decree, Lee came into the operating trailer and informed me that "String Bean" bought his way into the expedition by offering us the use of his Signal/One, Collins 30L1 and a trapped "V." That in itself should buy anyone into a DXpedition. Now I listened a little closer: WB2OEU was his call, Fred was his name, and he had an Extra Class Ticket. I said, "Okay, you're in, but bring your own food, drink, and a bedroll." I got to know Fred quite well during the stay on the island, and much of our work on 75m was WB2OEU's fine operating.

We began using our own calls as portable to test the equipment about 1800 GMT and were disappointed that the propagation would not be optimum that evening. About 2100, strangers invaded the area and all indicated that they were hams. At one point there were twelve people watching operations in the operating trailer that could hold only four operators comfortably. Some of the scoffers came by to "help" after all the work was done and the fun ready to begin. Seven of us had done the leg and paper work, the assembly of equipment, the erection of equipment, and now we were being offered "help." One cigarette being snuffed out on my trailer floor and a paper cup of coffee atop my linear was not enough to arouse my ire – but when cables and cords were being upset, I saw red and probably made a lot of enemies among the ham community.

We logged nine hours of CW on forty with a little DX; we gave Squaw Island as the QTH. For those more curious we gave the geographic coordinates. Unless you're accustomed to copying three-letter code groups or you moonlight as a ship's radio operator, forget it. We have tapes of contacts who were given geographic coordinates and their comments are rare entertainment every time we listen to the playback. By 1100 GMT, twenty started to turn hot and we had a ball with European stations. We added a further clue to the location of Squaw Island, "We're four hundred miles from New York City." This disclosure placed us in the Atlantic Ocean to some listeners. Good Samaritans, helpful to a fault, began warning stations that we were bootleggers operating a 10 kW transmitter. We dropped another hint . . . we had a paragraph on page 101 of QST March 1971 issue . . . still we were thanked for a "New Country" by calling stations. Old residents of the area called in and went along with the DXpedition; one was so dumbfounded he said, "Why, that's the city dump!" I might add that some Good Samaritans recorded on tape cannot be found in any Callbooks, but they do have class in selecting calls.

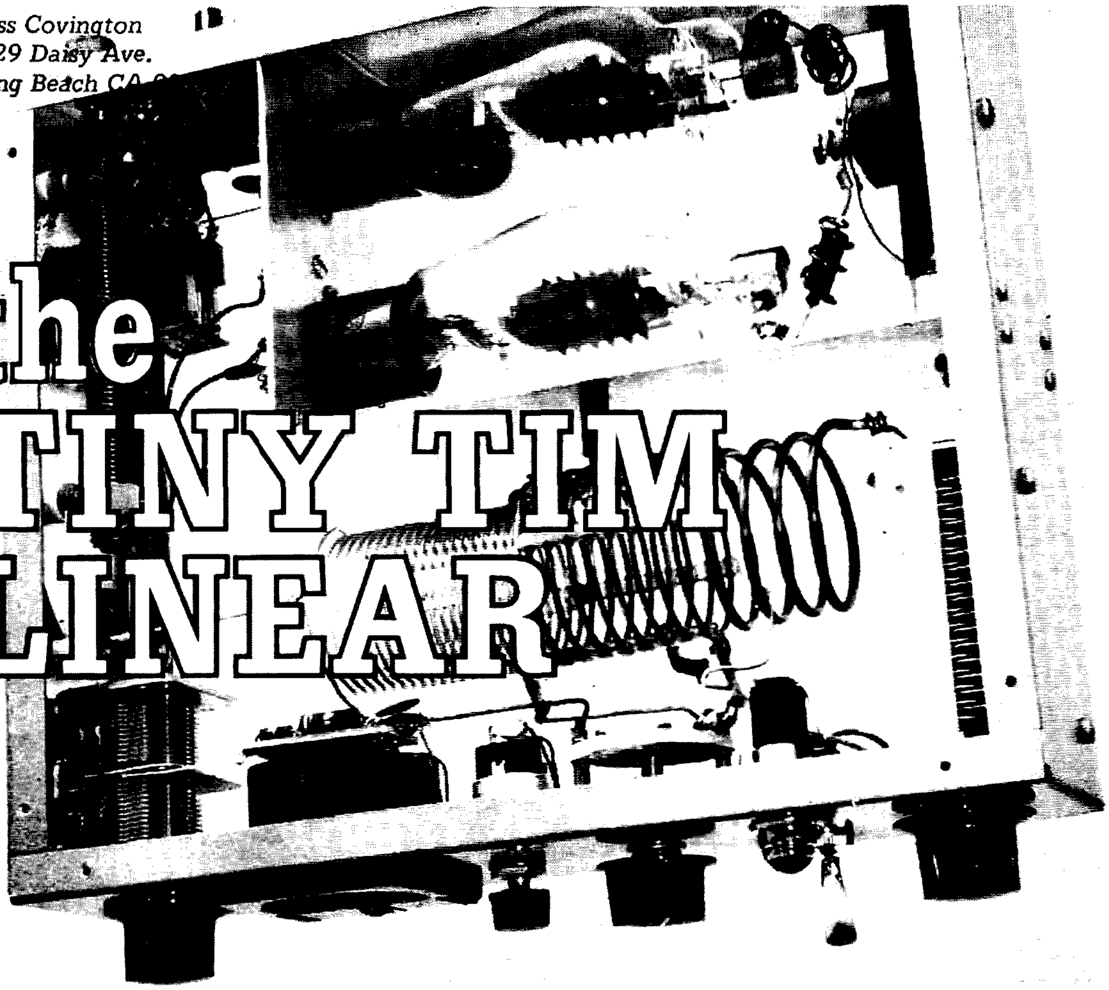
What did we accomplish April 1st? Well, forgetting the work, we did have a lot of fun. We did set up a first-class operating facility efficiently and quickly that could be activated once again if an emergency arose. Amateur radio was

publicized in the press and the public was made aware of our existence. K2DSO appeared on TV for a full half-hour interview show. We have two speaking engagements booked to date; we have several shoe boxes of QSL cards to reply to, and what is most important, Rare DX came toward the U.S.A. for a change. Would we do it again? Well, maybe not Squaw Island, but there are other islands waiting to be conquered, and just yesterday the airline pilot member of our DXpedition (WB2QDA) suggested that he could get a "chopper" to airlift our party to the brink of Niagara Falls to give the world one of the Three Sisters Islands. How does KS2SSY sound? Or a station on Goat Island even closer to the brink of the falls, KG2OAT?

. . .WA2JLF■

Russ Covington
2229 Daisy Ave.
Long Beach CA

the TINY TIM LINEAR



Tiny Tim was born from the need of a little extra punch when using my SBE 33 from our small travel trailer. I knew it had to be small to please the wife in not taking up the much needed space. I discovered the best place to hide the ac power supply would be in a corner under the dinette seat.

Tiny Tim's body is only 3 in. high, 12 in. wide, 10 in. deep, and will tune 80–10 meters. It also includes a built-in antenna relay and an rf output indicator. It fits perfectly on top of the SBE 33, as shown in the accompanying photos, but is adaptable to other transmitters and transceivers. This compact linear will run 500W dc input on SSB with 1500V on the plates of the two 811As in grounded grid. I am running only 1200V on the plates and find this adequate for my needs.

Although I have only used an ac power supply with *Tiny Tim* a mobile dc supply of as little as 800V would provide an adequate boost for low-power transceivers. Even at this low voltage, it would deliver close to 500W PEP input. The 6.3V filaments are wired in series for possible use with a 12V dc system. The open chassis design gives good natural ventilation, along with ease of construction.

Tiny Tim was fun and easy to build, and should appeal to those hams in the very low income bracket like myself.

Tiny Tim Circuit

I decided on 811As because they do not need a bias supply and are not expensive for the power they deliver. They also work well following a low-power exciter, and require as little as 20W driving power on all bands. The circuit is nothing startling, but a proved one squeezed down for simplicity and compactness. Many parts can be scavenged from the junkbox, TV, and old radios. The filaments are kept above ground with a homebrew choke and

driven directly from coax input from the exciter. The plate choke is wound on a plastic rod and held in place at the ends. The plate tuning capacitor is from an old ARC-5 transmitter, and the antenna tuning capacitor is a two-gang type from an old radio with the stators wired in parallel. The tank coil is smaller in diameter than the garden variety used in most, but the Q is correct and works well. The extra contact on the tank switch can be used on 80 meters to add extra capacitance in cases where the load resistance happens to be unusually low or reactive.

The antenna relay is a four-pole double-throw I had, but a 5A three-pole is all that is needed. I used the third pole contacts to lift the filament centertap from ground on standby. This keeps the transformer much cooler. For those using *Tiny Tim* with the SBE 33, you will find 10V dc on the octal male plug at pin 7 for controlling the antenna relay, but be sure and use a two prong plug that is insulated from the linear chassis. Consideration should be given to the relay control voltage, if used with other units than the SBE. The output meter provides the necessary indication for loading the amplifier, and the 25 kΩ pot keeps the reading in the proper scale, along with a push-pull switch on the back to control the antenna relay for tuning just the exciter, or turning off the linear with the ac power switch still on.

Almost any of the power supplies shown with linears of this plate voltage requirements will work. I used an old husky TV transformer and a surplus capacitor with some bargain high voltage diodes. No choke is needed in my supply; this helps make the unit easier to hide.

Tiny Tim Construction

Tiny Tim is built inside a 3 x 12 x 10 in. aluminum chassis with the top cut out leaving a half-inch ledge the same as on the bottom. (See Fig. 1.) Allow extra diagonal metal in the corners for mounting the

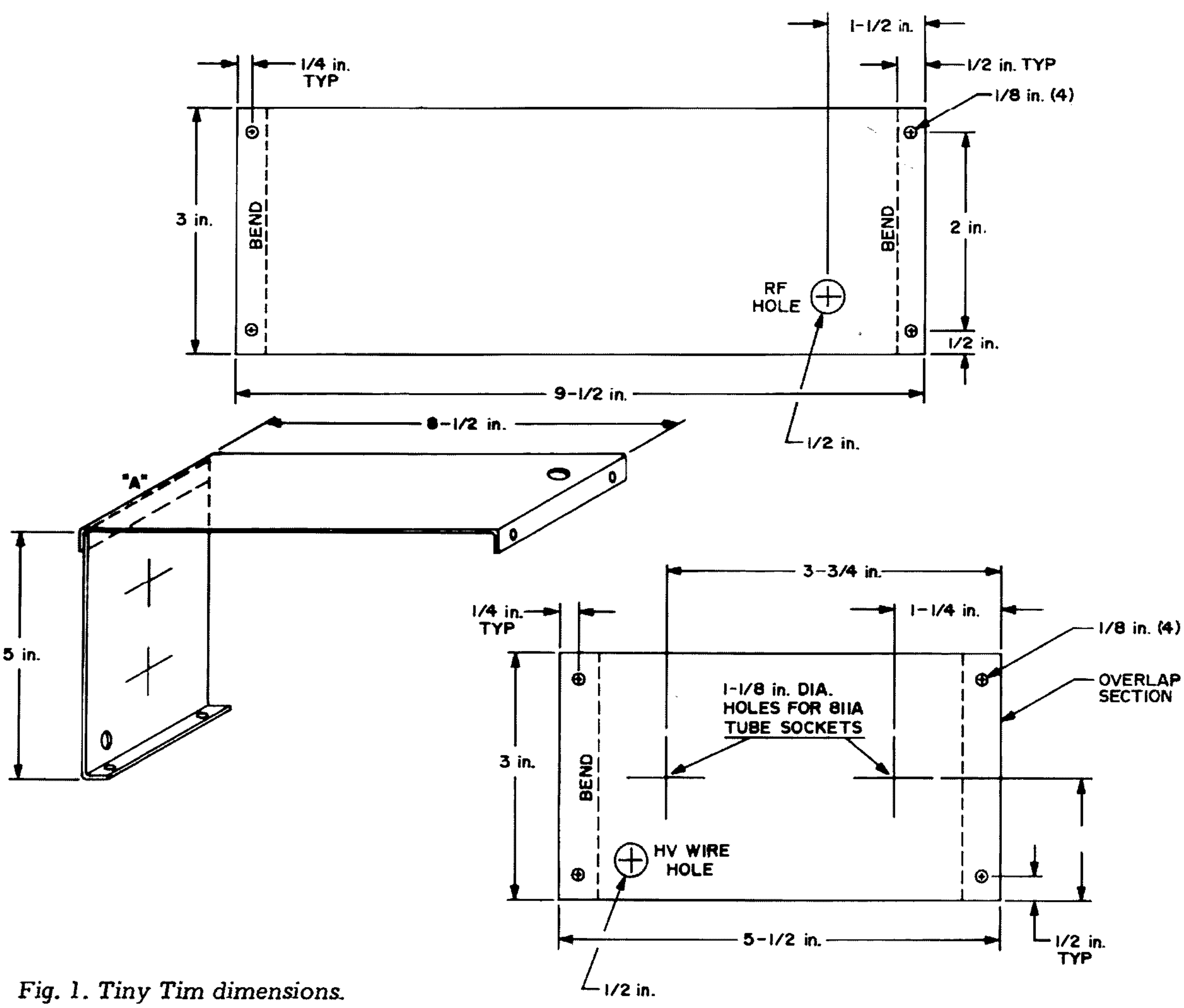


Fig. 1. Tiny Tim dimensions.

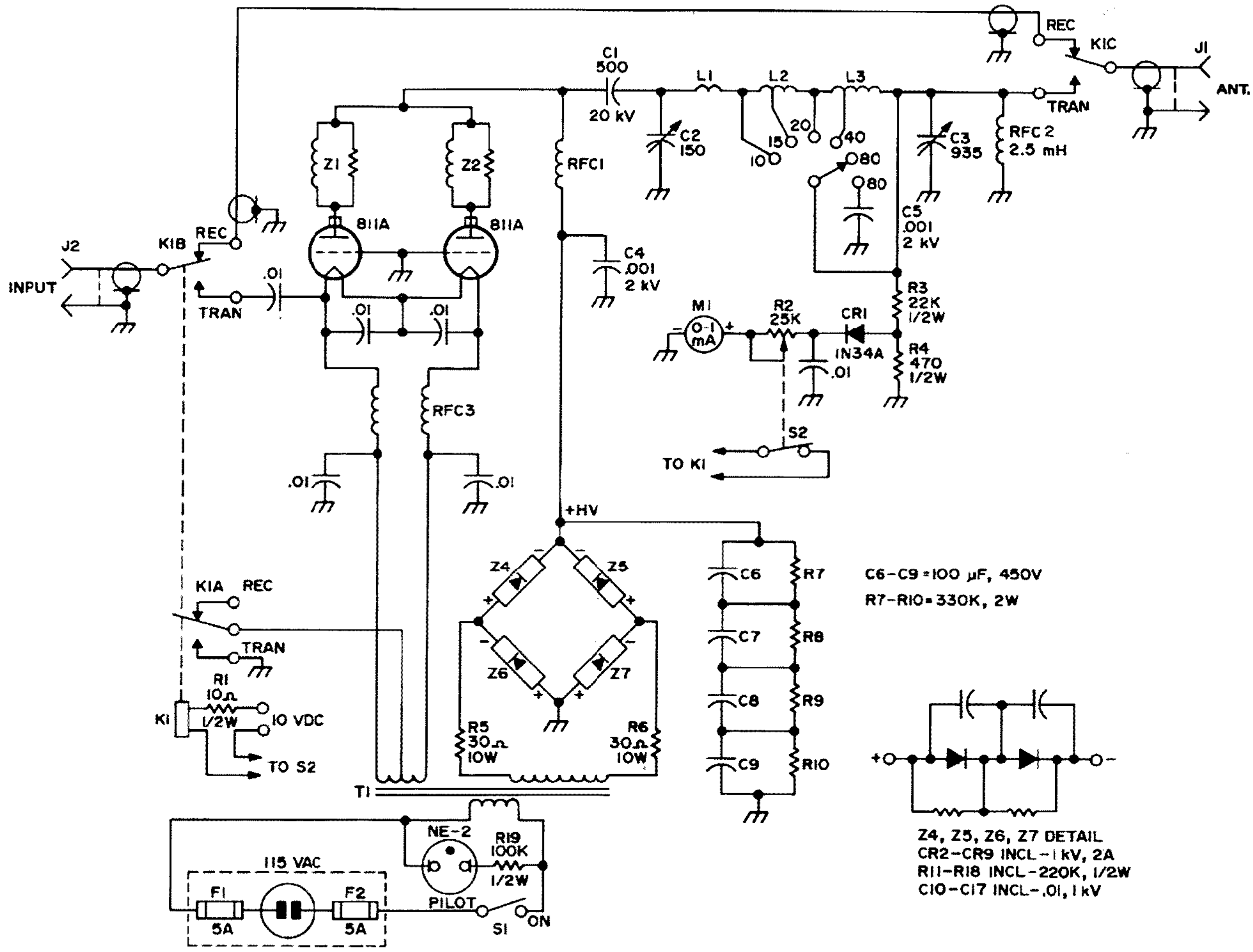


Fig. 2. Tiny Tim linear amplifier schematic diagram.

Capacitors

C1 – 500 pF 20kV TV-type high voltage (Allied 43A5599)
C2 – 150 pF var. (Johnson 250E20)
C3 – 935 pF var. (Allied 43A3528)
C4, C5 – .001 μF 2kV ceramic (Allied 43D6290)
C6–C9 – 100 μF 450V electrolytic (Allied 43A4547)
C10–C17 – .01 μF 1kV disk ceramic
CR1 – 1N34A
CR2–CR9 – Silicon diodes - 1kV 2A each

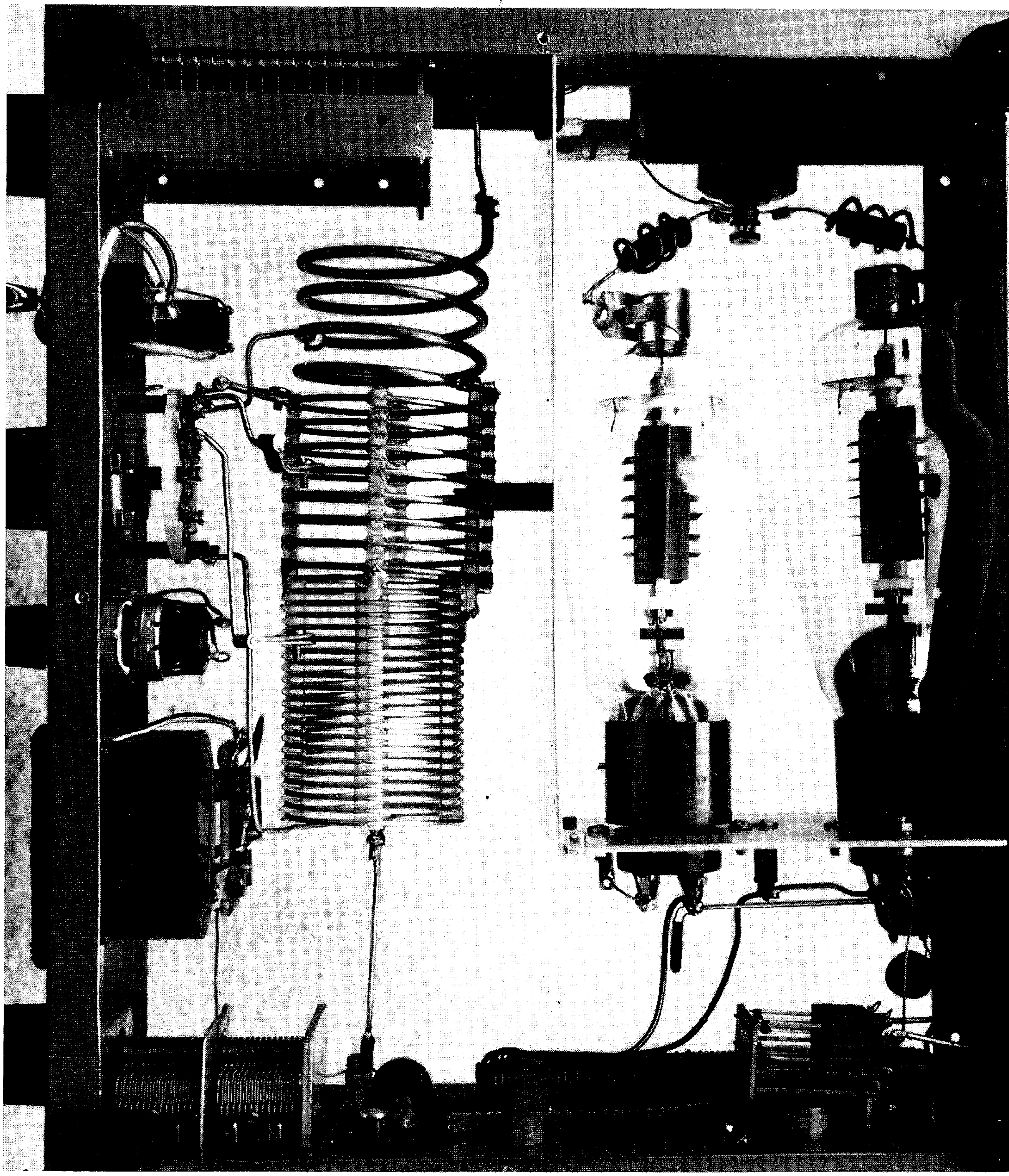
Note: All capacitors 600V ceramic unless otherwise listed

Resistors

R1 – 10Ω 1/2W
R2 – 25kΩ pot with push-pull switch (Lafayette 33E14838)
R3 – 22kΩ 1/2W
R4 – 470Ω 1/2 W
R5,R6 – 30Ω 10W
R7–R10 – 330 kΩ 2W
R11–R18 – 220 kΩ 1/2W

Parts

T1 – TV power transformer 350 mA (with 4A fil)
S1 – Single-pole single-throw toggle (Olson SW412)
S2 – Push-pull SPST switch on back of R2
S3 – Single-pole, 6-pos. ceramic rotary (Centralab 2501)
K1 – Relay 4-pole, double-throw, 5A contacts, 6V coil (Olson SW468, Potter & Brumfield GA23671)
RFC1 – 90 μH, 500 mA 4 in. closewound No. 26 Formvar on a 5 in. long, 3/4 in. dia solid plastic rod
RFC2 – 2.5 mH rf choke
RFC3 – 28 bifilar turns No. 14 Formvar or Nyclad wire closewound on 1/2 in. dia, 5 1/2 in. long ferrite rod (Lafayette 32R6103)
L1 - 4 turns, No. 10 wire, 1 3/4 in. inside dia, 1/4 in. spacing
L2 – 8 turns, 2 in. dia, 4 tpi (AirDux 1604)
L3 – 21 turns, 1 3/4 in. dia 8 tpi (AirDux 1408)
COIL BAND TAPS – All taps measured from end of C2
10m 2 1/2 turns
15m 4 1/2 turns
20m 7 1/2 turns
40m 17 1/2 turns
80m all of coil
M1 – Dc milliammeter, 0–1 (Allied 52A-7614)



Inside of Tiny Tim.

I1 — Ne-2 panel mount neon lamp
J1,J2 — Coax connector, chassis mounting (SO-239)
F1,F2 — 5A fuse, fuse-in-plug assembly
Z1,Z2 — Parasitic suppressor, 100Ω 2W carbon resistor assembled inside 2 1/2 turn coil of No. 16 tinned, 1/2 in. dia, 3/4 in. long

Amplifier chassis — 3x12x10 in. aluminum (Allied 42A7854)
Power supply chassis — 3x5x13 in. aluminum (Allied 42D7906)
Minibox 2x3x5 in.
Male/female, multiwire connectors series 78 and 86, eight contacts (Allied 47D0528 and 47D0508)

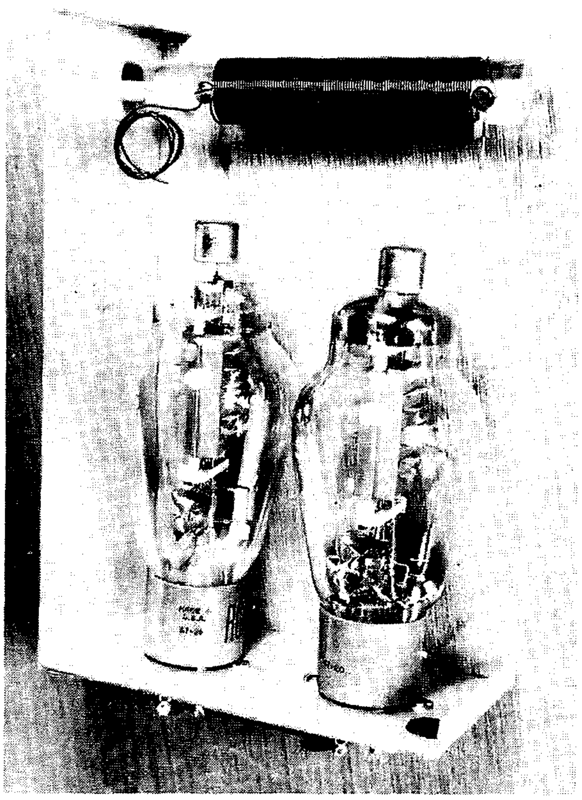
rubber feet. Cut two 3 in. strips from the leftover scrap for the rf section divider, and assemble as in illustration. Care should be taken on construction of the divider as the tube tolerance is quite close.

It is important that the filament pins (large holes) on the tube socket should face each other on assembling to prevent filament sag. Although the tube filaments are shown in series for a 12.6V transformer, they could be paralleled for 6.3V.

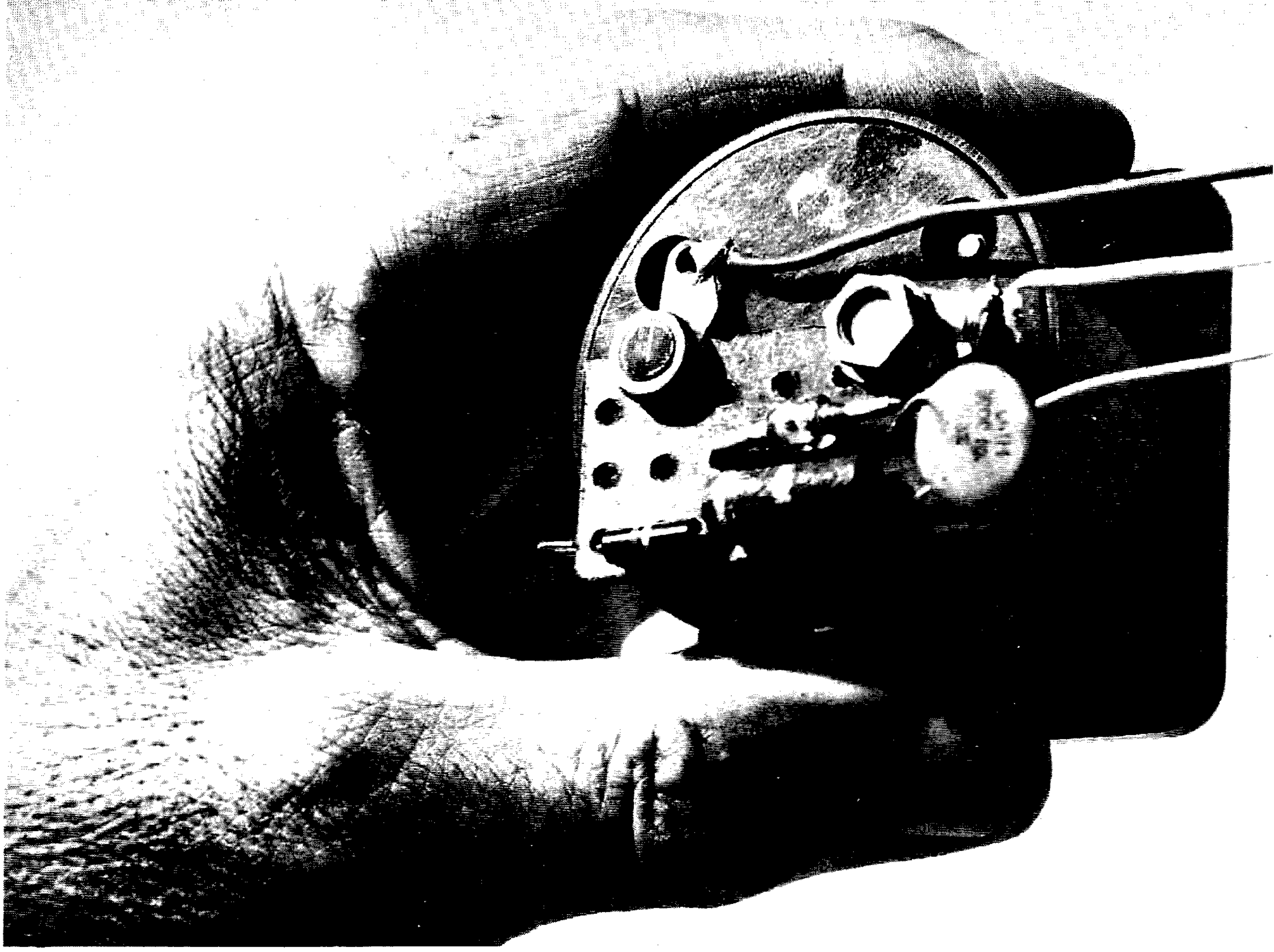
High-voltage blocking capacitor C1 (Fig. 2) was taken from an old TV high voltage cage and screwed into a half-inch standoff insulator.

Plate choke RFC1 was constructed of plastic rod cut to 5 in. in length, tapped at both ends for mounting screws, and also tapped at the sides for the start and finish position of the winding.

The three sections of the tank coil were first cut to the right number of turns, then soldered to the end turn of each coil, and held together, where the plastic sections meet, with epoxy cement. Centering of the tank coil in the chassis is important to its



RF choke and 811A mounting detail.



Meter rectifier detail showing mounting on rear of meter.

operation. The coil is held at the center by a standoff insulator secured to the rf divider, but care should be taken when soldering to the turns of the coil that you don't short out the next turn.

The filament choke is made by winding two side-by-side (bifilar) lengths of 14-gage wire on a 0.5 in. ferrite core cut to 5½ in. Leave enough length on the ends of the wire to reach to the power plug and filaments. Make one wrap of plastic over the core before starting your winding. A couple of plastic straps screwed to two standoff insulators hold the choke firmly to the side. RFC2 is mounted on the same side at the end of antenna tuning capacitor C3.

The metering rectifier unit is all mounted on a 2 x 2 in. Vector board, and held to the back by the meter lugs.

The three wires from the ac power switch are run in shield under the chassis ledge to the power plug on back. High-voltage capacitor C4 and the filament bypass capacitors are mounted at the power plug.

The top and bottom covers of the amplifier are cut from a sheet of perforated aluminum (do-it-yourself type) available in most hardware stores, and held in place with metal screws.

In trying to keep my ac power supply small as possible, I sacrificed a few watts by using an old TV transformer instead of the higher voltage one I intended to use. After building a bridge rectifier, the dc no-load was just over 1200V. The on-the-air reports are so good that I am not sorry for my choice. The transformer was fastened on its side inside of a 3 x 5 x 13 in. chassis with the filter capacitor secured at the other end. Placing a piece of plastic under the capacitor helps to reduce any possible flashover. There is plenty of room left for the standoff insulators and resistors.

Fasten a piece of pegboard over the capacitor area, leaving a 2 in. space from

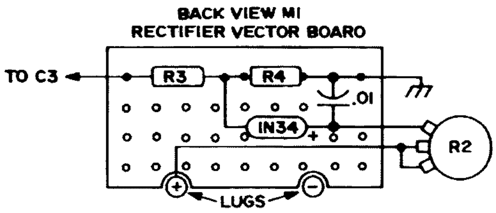


Fig. 3. Meter rectifier board.

the transformer for the barrier terminal strip. On top of the pegboard is fastened a 2 x 3 x 5 in. minibox that holds the rectifier diodes on two terminal strips with the leads going out the bottom. The shielded rubber covered 8 ft power cord passes all the way through the cover, with the leads screwed to the terminal tie strip. Another piece of pegboard over the terminal block area will completely eliminate the possibility of accidental shock.

A male type TV ac connector, mounted flush on the side of the chassis, is a safe quick way to be sure your power is completely disconnected.

Half-inch rubber feet are mounted at the four corners with metal screws, the same as on the linear.

Check all wiring at the relay and power plug with an ohmmeter for possible shorts before applying the smoke test; it may save a few parts.

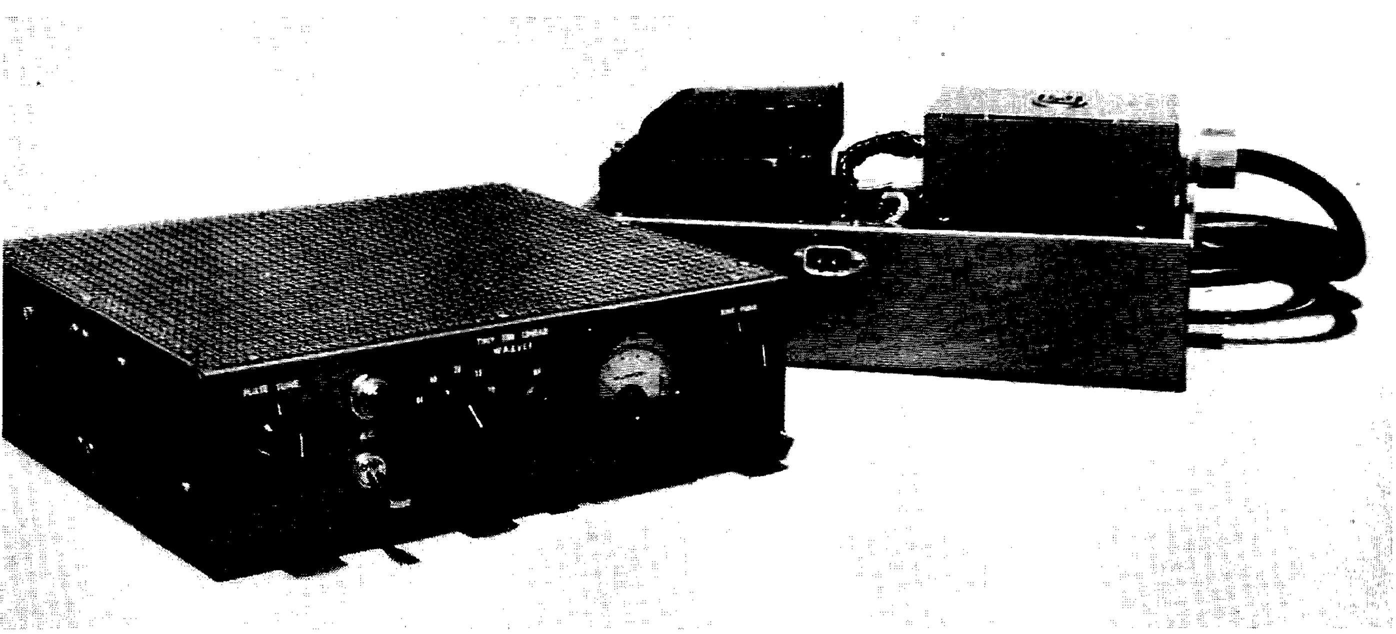
Keep in mind that although *Tiny Tim* is small, the knockdown voltage is big and you might not get up.

Tuneup Procedure

Load your exciter into a 52Ω dummy load with linear amplifier relay switch S2 off. Note that the antenna relay is still active with S2 on, even when the linear ac power switch is off. After normal exciter loading, turn on antenna relay switch S2, and center the meter output control. Switch your exciter momentarily to tune, and swing plate tuning capacitor C2 for the most output indication on the meter. Repeat with antenna loading capacitor C3, and again with C2 until you have peaked the output with the meter set in the upper scale.

To check for proper operation of the tank circuit for efficiency on each band, antenna loading capacitor C3 stator plates should be considerably less than fully meshed. This can easily be corrected by changing the band tap, and adding one more turn to the tank coil.

After loading the linear on your favorite band, carefully loosen the setscrews on the tuning knobs C2, C3, and the output meter control knobs, adjust so that the knob markers are all vertical. This will give a reference for future tuneups. . . .WA6VLI■



Tiny Tim and AC power supply. Note male AC connector on power supply and the box over the diodes.

Ooops . . .

K6MVH's "Gain Antenna for VHF/UHF Repeaters" is not really so non-critical that all dimensions can be left to the reader's imagination. Neither can it be said that we purposely deleted the dimensions to test how alert our readers really are. Actually, somebody goofed and forgot to put the dimensions onto Figure 1. The dimensions for this antenna are: 2 meters: A = 19", B = 13.3", C = 26.6". 450 MHz: A = 6.33", B = 4.44", C = 8.875". 220 MHz: A = 12.66", B = 8.88", C = 17.75".

FOUR Tube Station

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West Monroe LA 71291

The four-tube station is the result of a long-time desire for a small, compact transmitter-receiver combination that will work well on 80 and 40 meter CW. I wanted it to be ready to go at a moment's notice, either as a standby rig at home, or on that occasional vacation trip.

The Receiver Section

Three of the four tubes are used in the receiver. The other is in the transmitter. You probably are already questioning how well a three-tube receiver will work on these two crowded bands. Take my word for it: it works real well. A 6EA8 is used as the mixer-oscillator, a 6BA6 serves as a regenerative i-f amplifier, and a 6GW8 is the first audio and audio output stage.

Much of the success of the receiver can be attributed to the i-f amplifier. By using regeneration the gain and selectivity of the receiver is increased greatly. The i-f is 1700 kHz, so image problems are reduced considerably. By using this frequency the oscillator does not have to be switched when changing bands. It tunes from 5.200 to 5.700 MHz. With a little mental arithmetic you can see that this will give a 17.00 kHz difference when the antenna circuit is tuned to either 80 or 40. The antenna circuit is tuned by a variable capacitor with sufficient capacity range so that both 80 and 40 can be covered; so no bandswitching is necessary in the receiver.

Both the antenna and oscillator coils are wound on ½ in. slug-tuned forms. This makes it possible to adjust the inductance to just the value needed without a lot of trouble.

A 1N34A general purpose diode is used as the second detector. This is followed by the 6GW8 which provides plenty of audio for speaker operation. The headphone jack is a two-circuit type. The two circuits are tied together; this arrangement is used to allow use of the low impedance stereo type headsets that are so popular now.

The Transmitter Section

A 6146 is used as a grid-plate crystal oscillator. With the power supply shown it is possible to run about 40W input. The circuit is very simple. A pi-network tank is used in the plate circuit so that the transmitter will match any 50–70Ω load. Both the plate tuning and antenna loading capacitors are the cheaper broadcast type. The latter is a two-gang affair with the sections in parallel.

The plate tank coil is wound on a 1¼ in. plastic pill bottle. So that the inductance and capacity will be right for each band, the coil is tapped and a cheap slide switch is used to short out a portion of the coil on 40 and in the 80 meter position additional capacity is added across the antenna loading capacitor.

The Power Supply

The power supply is a straightforward affair using silicon diodes as rectifiers and a simple RC filter. The transformer can be from an old TV receiver, or any other transformer capable of delivering 350V dc at 125 mA or more.

The send-receive relay is a standard four pole, double-throw job. Only three poles are used. The coil is designed to operate on 117V ac. A toggle switch controls this relay. Another toggle switch is used as the main power switch.

Construction

The four-tube station is built on a 7 x 11 x 2 in. aluminum chassis. Before you

begin construction, take a good look at the photographs so that you can get a good idea where to mount the major parts. The layout is not extremely critical, but I suggest that you follow the same general arrangement.

Arrange the major parts and mark their location so that the necessary mounting holes can be punched or drilled. Mount these parts. Before you mount the 25 pF receiver tuning capacitor it would be wise to lay out the front panel so that the dial can be mounted. There must be good alignment between the dial and the capacitor so that the tuning will be smooth.

You will note that liberal use is made of terminal strips so that the smaller parts are held in place securely. It would be wise if the coils in the receiver, as well as the one in the transmitter, are coated with a good grade of coil dope.

The front panel on my rig was cut from a sheet of prefinished Masonite. It is 3/16 in. thick and measures 7 x 12 in. The controls are labeled with decals.

I left the installation of the relay until last. When it is mounted connect the proper wires to it. Small coax is used in the antenna circuit. Be very careful in connecting the leads to the relay. Be sure you are right.

With the rig plugged into a 117V ac outlet, the tubes in their proper sockets and a speaker connected to the speaker jack; turn the ac on. After about a minute of warmup time, you should hear a slight hum from the speaker. Turn the regeneration control fully clockwise. This puts maximum screen voltage on the i-f amplifier. You should hear background noise with this setting. If you have a 1700 kHz signal source you can align the i-f very easily. Connect a VTVM between the capacitor side of the 1N34A second detector and the chassis and adjust the four slugs of the two i-f transformers for maximum indication. As the i-f amplifier is aligned it will be necessary to back down on the regeneration control to keep the i-f from oscillating.

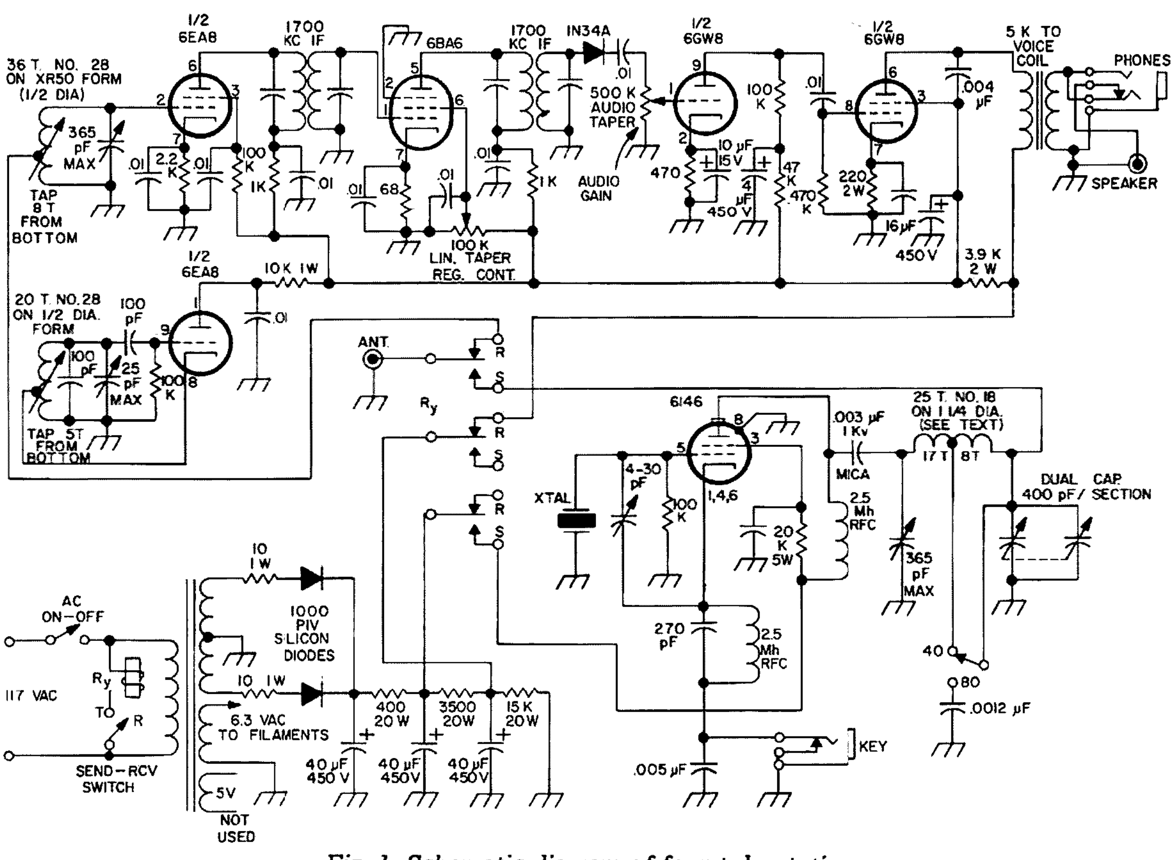
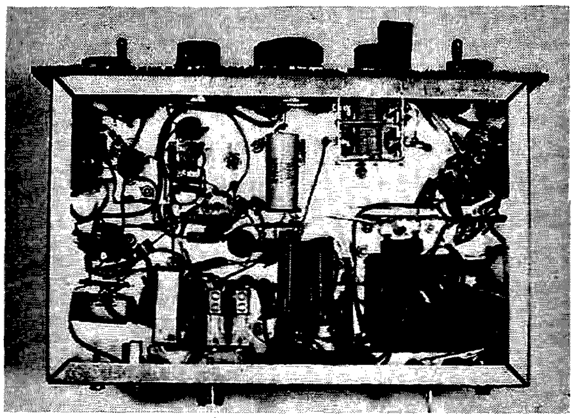


Fig. 1. Schematic diagram of four-tube station.

Next set the oscillator. This can be done in a number of ways; probably the simplest is with a general coverage receiver. Set the general coverage receiver to 5.200 MHz. With the dial tuned so that the tuning capacitor is fully meshed, slowly adjust the slug of the oscillator coil until a signal from the oscillator is heard in the other receiver. This signal will be easier to hear if the bfo is on. With the tuning capacitor set to minimum capacity you should be able to hear a signal near 5.700 MHz.

Tune in a signal near 3.500 MHz and with the antenna tuning capacitor fully meshed simply adjust the slug in the antenna coil for maximum signal.



Underchassis view of transceiver.

Adjustment of Transmitter

With either a 40 or 80 meter crystal in the crystal socket, a key plugged into the key jack, switch the transmitter on. Press the key and listen to a nearby receiver tuned to the crystal frequency. If the transmitter is oscillating you will hear it. If not, you will need to adjust the compression-type trimmer capacitor located in the 6146 grid circuit. This capacitor should be adjusted so that the oscillator starts smoothly when the key is pressed. Caution: Do not hold the key down too long – the plate circuit is off resonance!

The tuning of the plate circuit is like any other pi-network. To check out the rig a 25–40W lamp connected to the antenna connector will serve as a dummy load. A 200 mA meter plugged into the key jack will help in loading up.

. . .W5LET■

Wells Chapin W8GI
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All's Well In Amateur Radio?

We are not losing our bands, we are gaining bands, our numbers are increasing at the rate of CB at 100,000 per year, youth is flocking to our hobby, we have only one representative to the FCC, our ranks are not divided into incentive vs non-incentive, CW vs Phone, etc., our wonderfully efficient ARRL is not losing money but is furnishing $2,000,000 a year as a nonprofit organization to run its powerful lobby from its Washington headquarters, our efficient management team as moved ARRL headquarters from that quaint little town, Newington, Conn., where thc inaction is, to Washington where the action is. QST is now a first-rate reporting medium where you can read both sides of the story, almost all amateurs now belong to the ARRL, there is a very powerful world amateur organization, our public image is phenomal, and everyone knows about and loves amateur radio and last, and not the least, we have a 10-year written plan to plot a course for amateur radio that is supported by and contributed to by the powerful EIA lobby in Washington. Now let's put down our opium pipe and look at the facts.

Prophet of doom? Or realist? Take a look at the graph in Fig. 1 whose figures are taken from the FCC Annual Reports of the years 1958 through 1969. These figures are official fact and cannot be refuted. This slow-down in amateur radio growth and low percentage of amateurs in the ARRL is one of the key problem areas. Unless this trend is stopped, our hobby will slowly die.

This graphic picture is better than 10,000 words. It presents the basic problem in a nutshell. However if you look beyond these figures, and interpret what they are saying, the facts are pretty gruesome. CB, while it has only 860,024 stations, the total including mobiles licensed is a staggering 3,372,525. It is relatively simple to see that this is where the manufacturers are looking for a market and that's why the manufacturers through the EIA are pushing the FCC for more frequencies for CB.

It is interesting to note the membership in the ARRL pretty well follows that of the slow growth or even loss in numbers of amateur radio. The drop in membership, 35% in 1962 to 28% in 1969, closely follows controversial decisions made by the ARRL Directors and the lack of selling the decision by headquarters via QST. We make no real effort to sell all the amateurs on the ARRL. The only single written effort is that when a person receives a license from the FCC he gets a letter from the ARRL requesting he join. The only other effort is the corny outdated ARRL booth at various functions that is always

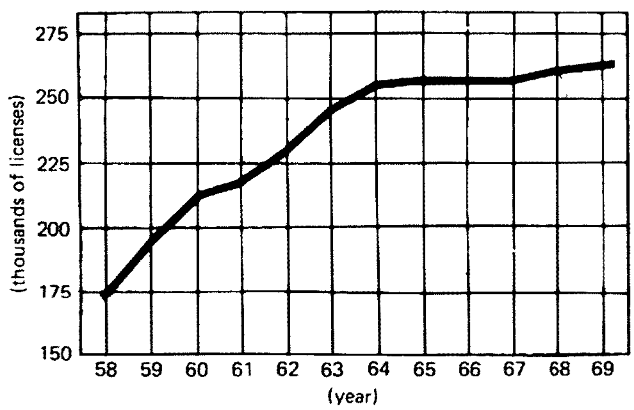

Fig. 1. Graph of total licenses issued from 1958 to 1969.

undermanned. Amateurs just won't flip over and play dead and accept the great ARRL. They must be sold and that requires public relations, good advertising outside of QST, and more important, a truly representative ARRL that expresses the desires of *all* amateurs.

Many questions arise that should be answered. Why has amateur radio growth stopped? Why is the ARRL membership so low? What has happened to the once very successful and agressive ARRL? Why has it lost respect at the FCC? Why is it losing money? Why are our bands being nibbled away? Why is youth not interested in amateur radio? What has happened to a once successful operation that has now become stodgy and ineffective? Why isn't QST a real reporting medium that prints both sides of the story? How good is its leadership? What can be done to revitalize the ARRL and amateur radio? Why don't we have a long-range plan?

Every successful business has a long- and short-range plan. How can you project finances without one? How can you anticipate change and hazards without one? Without a plan you are like a ship at sea with no destination, buffeted around by the wind and waves, never getting to shore unless it's by accident. Why do we resist change?

Change is the Name of the Game

Last year the "EIA" (Electronic Industries Association) went through a rather drastic organizational change. The NAB (National Association of Broadcasters), the largest and most powerful lobby in Washington, had an organizational renovation to make it more effective. Hundreds of corporations continued the realignment of their organizations to reflect changing conditions and to show a better return on their investment. Why do we amateurs resist change? Those who resist change generally die. Take a look at the old problems: the same old contests, the same old arguments, the same old names, the same old "lots of talk and no action" and so on, ad infinitum. We have been doing the same old things in the same old way since the birth of amateur radio. While we are complacently sitting, a population explosion, communication revolution and drastic world changes are swarming around us. We are like Rip Van Winkle – we are waking up in an entirely different, highly-competitive world. Only we are not like Rip; we haven't awakened as yet.

There are several things that can happen to amateur radio. Things can go on as they are with our ranks divided, other entities using and taking our bands, our real growth stopped, youth not very interested, our former mainstay, the ARRL, losing its effectiveness, losing the respect of the FCC, losing money. The League, which represents less than thirty-five percent (35%) of the amateurs, has become complacent and stodgy and is in general need of revitalization. Amateur radio will certainly slowly die as we are! Or we can make a turn-around and again be the highly respected healthy entity we once were. It's your responsibility – isn't it time for action?

. . .Wells Chapin■

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What bands would you like to see used?
What modes?
Please number the countries you need the most, **1–10**, in the order of greatest need. Check all the remaining countries which you need.

Any suggestions?

Please send to:
DX Editor
73 Magazine
Peterborough NH 03458

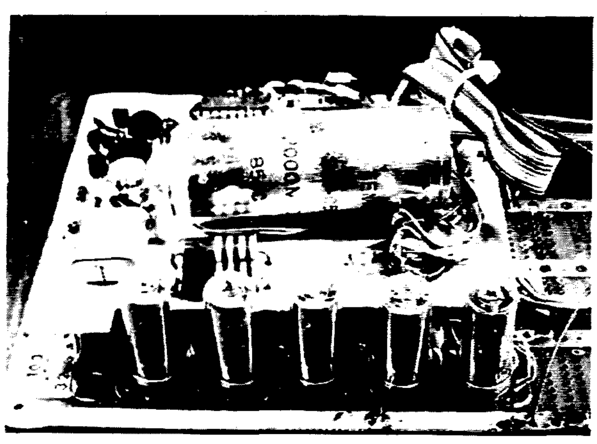
A DIGITAL READOUT FOR YOUR VFO

Richard Factor WA2IKL
Fed. Scientific Corp.
615 W. 131st St.
NY NY 10017

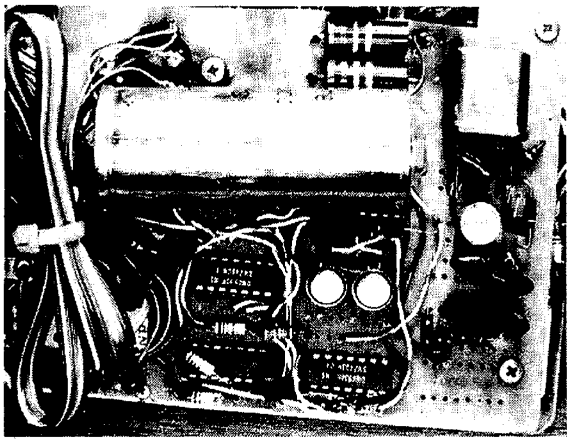
Are you on frequency? Are you within the band? Incentive licensing subbands have made this an increasingly difficult question to answer. Even if you have an Extra license, it is still nice to know where you are for net operation, OO work, etc. The declining price of integrated circuits and readout devices has made it unnecessary to continue to drool over the advertisements for that $1600 transceiver with the digital dial. A large percentage of currently manufactured gear can be fitted with a digital dial with greater accuracy, and very reasonable cost. Little modification of your gear is required, and what is required will not affect the resale value, since it is invisible and is easily removed.

As an extra added plus for the homebrewer, the digital dial makes unnecessary the greatest hate object of the electronic purist; the tuning dial; with its attendant impossibilities of getting linearity, accuracy, and above all, of inscribing, decaling, engraving, or calligraphing the dial in a neat, readable manner.

The device to be described is an adaptation of the basic electronic counter circuit. It takes the vfo signal of your receiver or transmitter and tells you what it is. Accurately. Not to the nearest kHz (with luck,



Front view of digital dial showing sandwich construction.



Top view of power supply and timing section.

at 57.8% relative humidity, with the rig on a cast iron bench weighted with two tons of sand and suspended in a mercury pool) but rather down to the nearest 10 Hz, almost always, with no precautions or requirements other than a periodic check to zero-beat the oscillator with WWV. If it is installed in a transmitter, it can measure received signal frequency by zero-beating the transmitter with the receiver. It can also measure frequency shift of an RTTY signal by zero-beating the mark and space frequencies and subtracting the two readings.

You know frequency counters are expensive and you're scared away by the price. Right? You shouldn't be – I mentioned that IC and readout prices are declining. Below is a comparison based on the advertised prices of the major components involved. I haven't included resistors and small components because you no doubt already have them. Even if you don't, the total should be less than $10. It is assumed that your rig has high voltage and filament supplies so that no power transformer must be bought.

Type	Quan	Total
SN7490	10	$20
SN7475	5	$10
SN7441AN	4	$12
B5750 (Nixie)	5	$25
1MHz Xtal	1	$ 5
		$72

This is effectively for the "worst case." i.e., no external oscillator, using 1 MHz crystal, 5-digit readout with storage. By eliminating the 10 Hz resolution, using an existing 100 KHz calibrator, and deleting the most significant digit, the price becomes drastically lower.

Type	Quan	Total
SN7490	7	$14
SN7441AN	3	$ 9
B5750	3	$15
		$38

The following parts are available from Circuit Specialists Co., Box 3047, Scottsdale AZ 85257. MPS 6520 98¢, MC724 $1.10, SN7400 45¢, SN7475 $1.50, SN7441AN $2.75, SN7490 $1.90. Add 35¢ for shipping.

Since dial drive mechanisms with less than one tenth the accuracy cost over $30, the price is not at all out of line. Incidentally, the prices quoted above are the highest you should have to pay. Due to a current oversupply in the IC industry, substantial discounts may be obtainable, and there is little doubt that prices will drop substantially between the time these words were written and the time the article appears in print.

Now that you have decided to build the digital dial, let's see if its circuitry makes it compatible with your rig. The rig should have crystal-controlled front end or conversion oscillator and a vfo covering a reason-

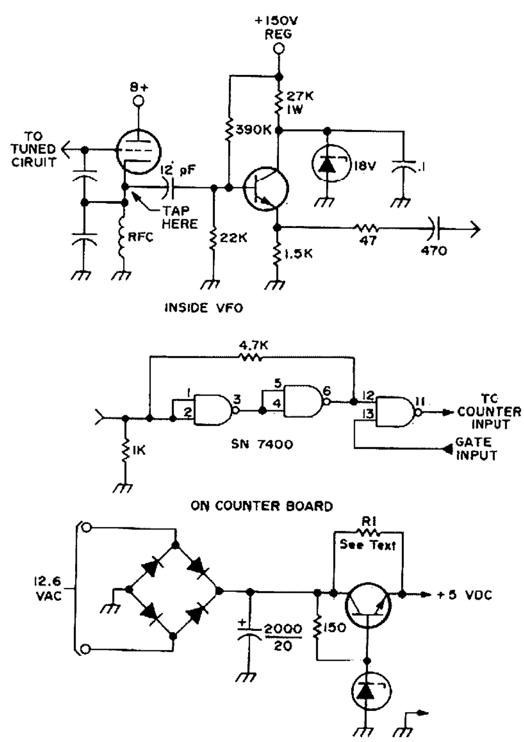


Fig. 1. Vfo isolation, input circuit, and power supply.

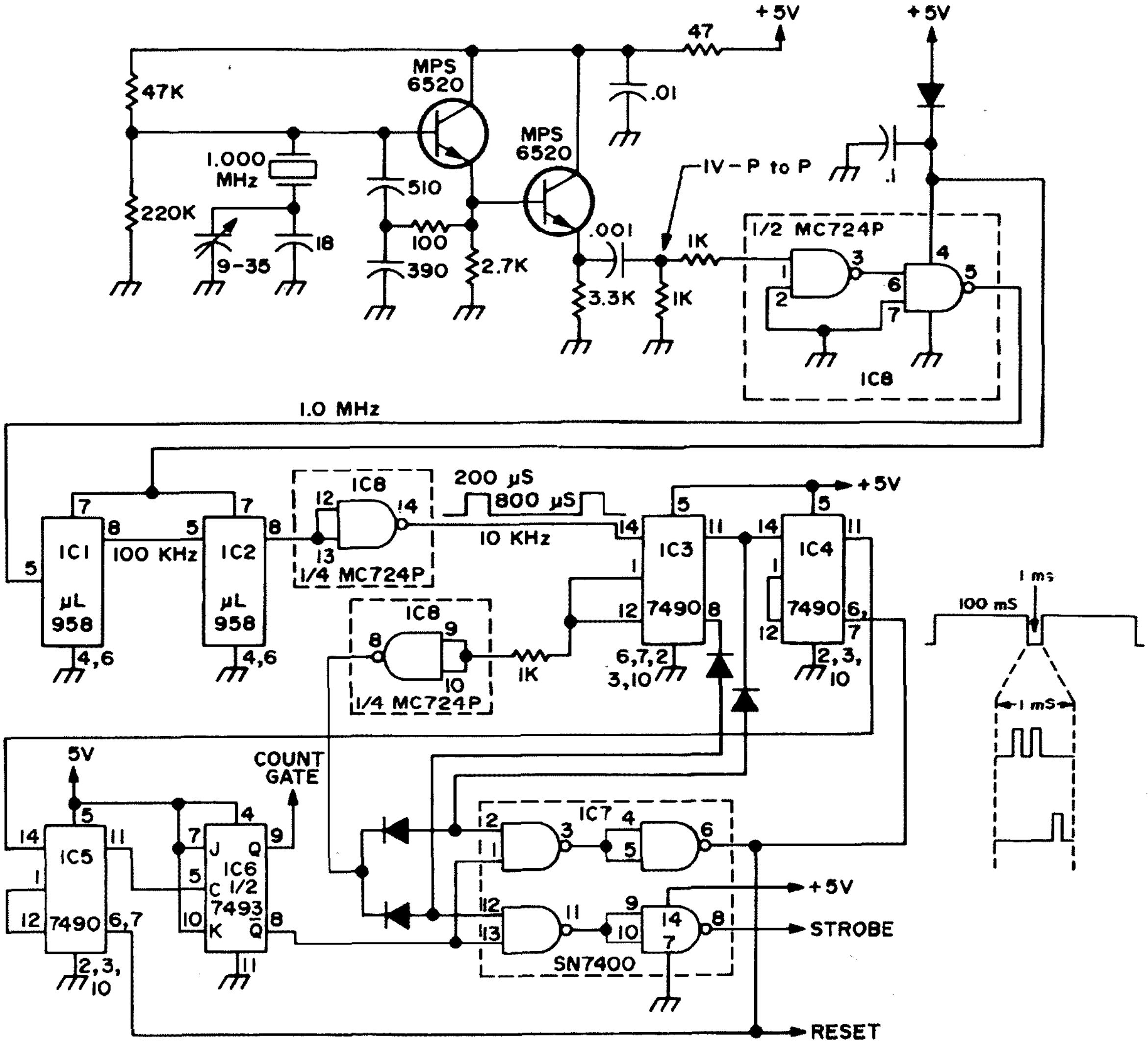


Fig. 2. Frequency-standard oscillator and counter control circuitry with timing diagrams.

able frequency range without odd number kilohertz tacked on. Ideally, a range of from, say 5.000 to 5.500 MHz would be covered. The unit can be used with a unit whose vfo covers, for example, 5.300 to 5.800 MHz with only minor changes. Input frequency is unimportant – anything up to 15 or 20 MHz is okay with the ICs specified. What is important is that there be no odd numbers at the end. A vfo covering 5.455 to 5.955 would be unacceptable. Of course, the counter will measure such frequencies as well as any other, but they will be impossible to mentally relate to the operating frequency. Another requirement is that the frequency mixing scheme be either additive or subtractive, but not a combination of the two. A quick glance at your instruction manual will tell you the exact vfo frequency and mixing scheme. If your rig tunes in the same direction on all bands, you should have no problem with the additive/subtractive question. If your rig does not fit the above criteria, I'll have a few comments on possible remedies, untried but theoretically sound, at the conclusion of the article.

The digital dial described herein is being used with my HX500 transmitter, whose vfo is 3.9–4.4 MHz, and which employs subtractive mixing. However, the principles and circuitry can be used with only minor modification in any transmitter or receiver fitting the above criteria.

The Circuit

The first step in going digital is to modify your rig. The digital dial needs +5V

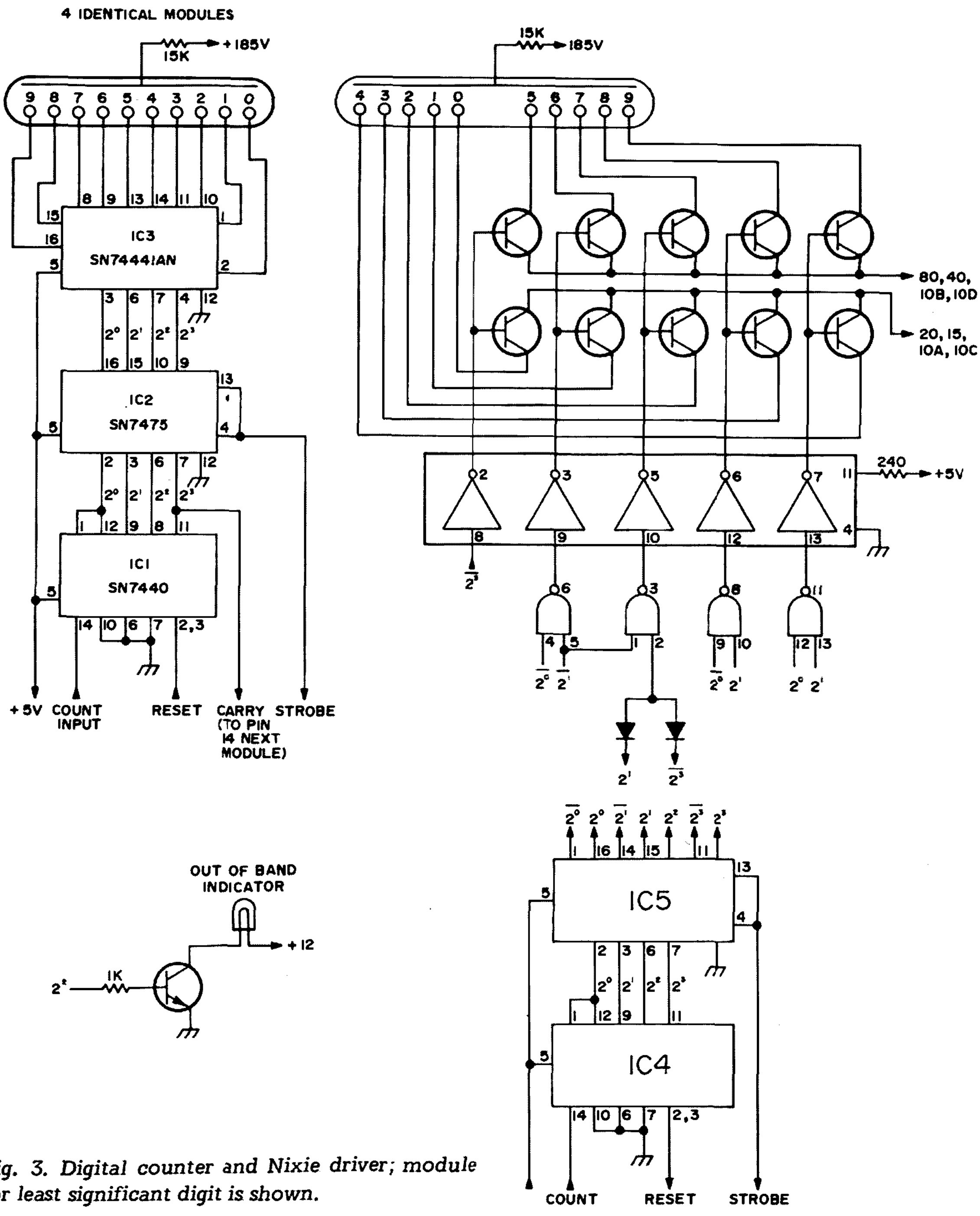


Fig. 3. Digital counter and Nixie driver; module for least significant digit is shown.

dc at about 500 mA, B+ at about 15 mA, and 1V of signal at the vfo frequency. To get the 5V, tap the filament supply (6.3 or, preferably, 12.6V and connect it to the bridge rectifier shown in Fig. 1. If your filament supply is 6.3V, it may be necessary to connect another 6.3V, 500 mA transformer in series with the filament supply. Nixie tubes like 170V at about 3 mA across them, but since they tend to act as voltage regulators, current limiting is necessary. Measure your B+ supply, subtract 190V, and calculate a resistor that will give 3 mA per Nixie with this voltage across it. Be sure to make a power calculation also, as a 2W resistor may be required. Small series resistors are connected to each Nixie to equalize current; the resistor just calculated goes to the junction of the series resistors.

The purpose of the vfo buffer is to make sure that the vfo in the rig is not disturbed. An emitter follower is ideal for this application. The component values

shown are for a supply of 150V, as this is the most commonly used. No trouble should be encountered if the pickoff capacitor (12 pF in the schematic of Fig. 2) is at least an order of magnitude smaller than the capacitor from the cathode to ground. The actual capacity will be much smaller, since the pickoff capacitor is in series with the transistor base, but it doesn't hurt to be safe. This completes the necessary modification of the rig. No damage to the front panel – see?

Circuit Description

The theory behind the electronic counter is that the number of cycles of the signal in a given period can be counted. If the period, for example, is 1 second, the number counted comes out to be cycles per second. Deriving the period precisely is done by counting down an accurate reference oscillator and then using the counted down signal to gate the signal to be measured.

The circuit works as follows (see Figs. 3 and 4). The input signal goes into a divider chain, the first stage of which is the least significant digit. After 10 pulses, the first stage is reset and a carry pulse generated. Since the counter has five stages and the counted frequency is in the MHz range, you can see that the counter will overflow several times during each count interval. However, we know what the first digit will be, so there is no point wasting a counting stage on it. All the stages are identical except for the most significant digit, which uses discrete components since special decoding is required.

After the counters have counted, the SN7441AN decoder/drivers ground the appropriate Nixie cathodes and the corresponding numbers light up. Between the counters and the decoder/drivers, one additional stage is necessary – a buffer storage register. The reason for this is that the gate time is 0.1 second, which will cause blurring during counting. If you wish to read out once per second, this isn't too bad. However, the dial is more useful when it's responsive, and you can zero in a frequency much more quickly when you don't

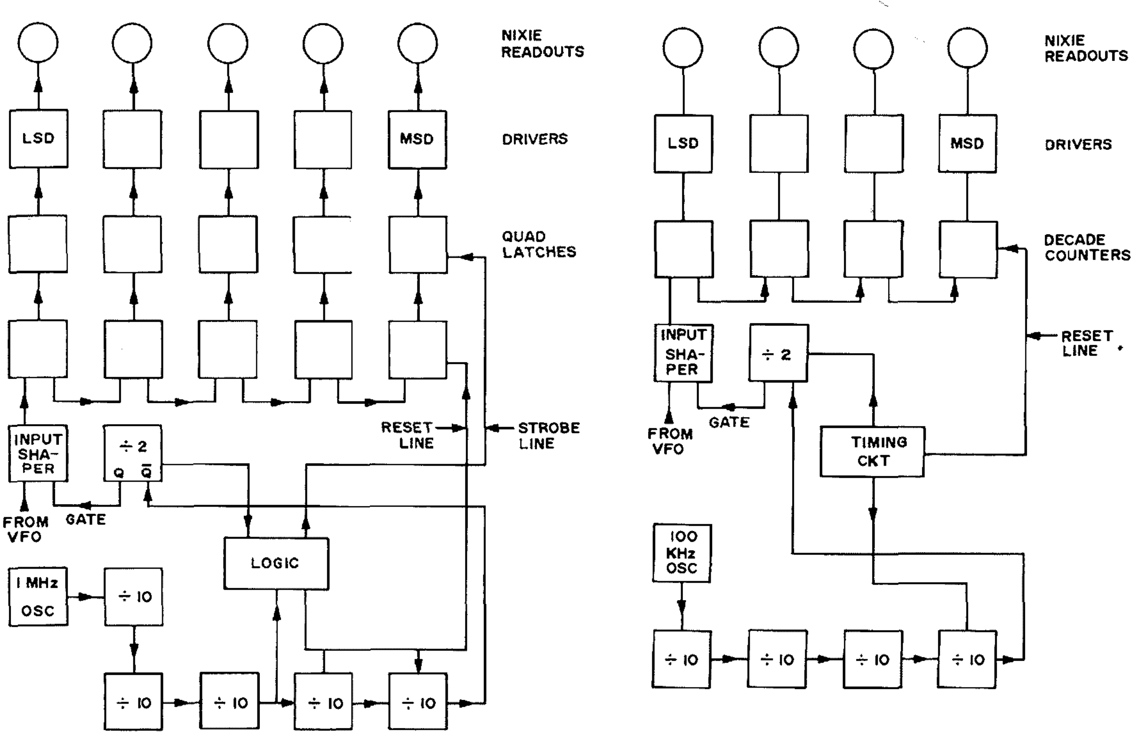


Fig. 4. Logic block diagram. The left block gives readout in 10 Hz increments at 101 ms intervals without blurring. The right block reads in 100 Hz increments; the update is adjustable and blurring occurs during 100 ms count.

have to wait a full second to see where the dial turn took you. By using storage registers and a few logic gates, it is possible to make ten 100 ms measurements in 10.1 seconds with no digit blurring. How this is done brings us to the timing circuitry.

First, an accurate frequency must be generated. The circuit shown in Fig. 2 is a stable oscillator designed for 32 pF crystals. A trimmer is included for fine frequency adjustment. There is no reason why the 1 MHz output of another oscillator can't be used. Approximately 1V (peak-to-peak) is required. You can also use a 100 kHz oscillator and delete one divider stage. The MC724P quad 2-input gate shapes the signal into a square wave suitable for triggering the dividers.

The first two dividers I used in my unit are Fairchild μL958s. I used them because I had them lying around, and it is okay to use SN7490s here. A section of IC8 is used as a buffer to make the two IC families compatible. If you use 7490s, delete this gate.

ICs 3, 4, and 5 are the remaining dividers. At time zero, let us suppose that IC6, the gate flip-flop, is reset (gate at logic 0). The carry pulse from the last divider brings the gate high, starting the count. One carry pulse later (100 ms), IC6 is again reset, stopping the count. (The abbreviation "ms" means milliseconds; μs" means microseconds.)

Here the fun begins. IC6 Q, being high, sets half of the *and* condition on the first two sections of IC7. IC3 is still counting from binary 0 to binary 9 at a rate of 1000 times per second. Its output states are decoded by the remaining inputs to IC7 in the following sequence: At binary 4 and 6, pins 12 and 13 are both high, causing pin 11 to go low, pin 8 to go high, and thus strobing data into the buffer register. The strobe is performed twice because doing so eliminates the need for an additional decode – the same data is strobed each time.

At binary 8, pins 2 and 1 of IC7 are both high, causing pin 3 to go low and pin 6 to go high, thus resetting the counter and resetting the last two 7490s in the dividing chain. However, these two dividers are reset to 9 instead of to 0. This means that just 0.1 millisecond later, when IC3 carries, IC4 and IC5 will also, starting the count again. Note that the total time between the end of the first count and the beginning of the next is just 1 ms, allowing almost 10 measurements per second.

Backwards or Forwards?

If your rig is of the subtractive mixing type, you are probably wondering how the readout frequency corresponds to the output frequency of the rig. It doesn't – everything is upside down. Of course, it will be accurate on one frequency in the middle of the band, but that's little comfort. Despair not. Instead, connect the Nixies to the counter backwards. (Switch 0 for 9, 1 for 8, 2 for 7, 3 for 6, and 4 for 5.) Through the magic of mathematics, for every 10 Hz increment of the vfo frequency, there is a 10 Hz decrement of the readout frequency. You can now see why I said that the rig can be additive or subtractive, but not both . . . unless you happen to have a two-position, 50-pole switch around.

Most Significant Digit

The one remaining readout problem is that of the most significant digit. If you want the digital dial to be accurate on all bands it must read: (3)745.92 kHz on 80 meters, and (7)245.92 kHz on 40 meters. One way this can be done is to have different drivers for the Nixie, and ground the appropriate one with an extra wafer on the band switch (see Fig. 5). By driving the bases in parallel and grounding the emitters of the appropriate group, a cheap and dirty "adder" is constructed.

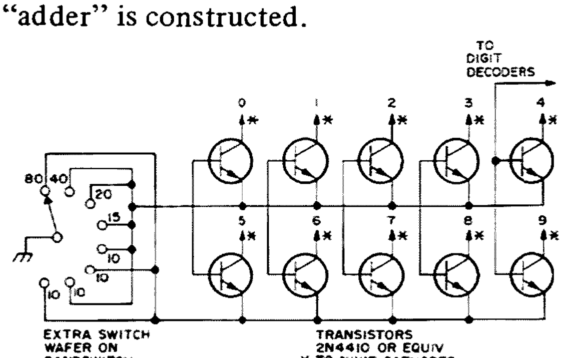


Fig. 5. Using a wafer switch to ground the appropriate Nixie drive for "adder" function.

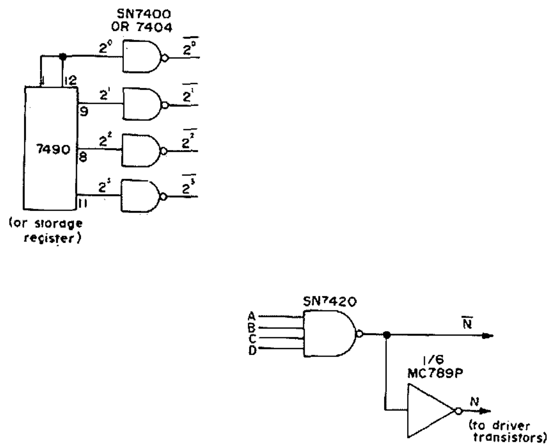


Fig. 6. General decoding scheme for all BCD states.

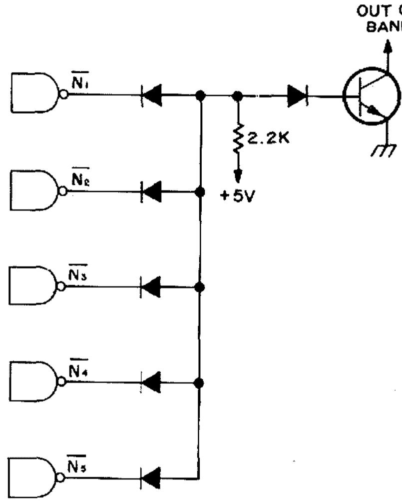
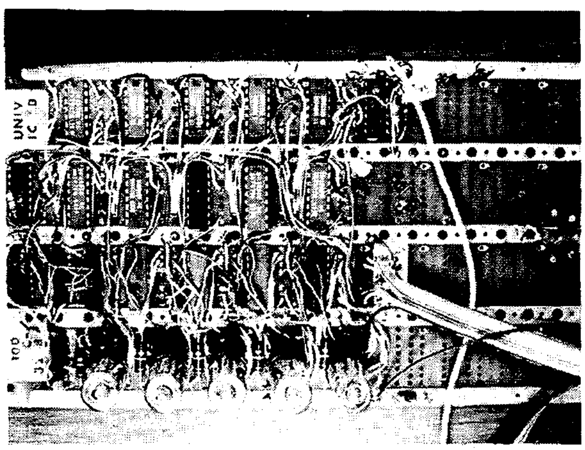


Fig. 7. An out-of-band indicator is constructed by anding the unused N states and feeding a simple driver.

If your vfo starts from some frequency other than an even megahertz, the decoder must be designed to match. If the vfo is, say 3.9 to 4.4 MHz (as is the HX500), where 3.9 corresponds to the top of the band and 4.4 to the bottom, then the decoding is as follows: 4.399.99 to 4.300.00 is 000.00 to 099.99 kHz on the dial. Thus, 3 must be decoded as 0; 2 as 1; 1 as 2; 0 as 3; and 9 as 4. To do this the gate that decodes a 3 binary state should drive the 0 (and 5) digit line, etc. The decoding section is fairly simple since only 5 states must be decoded, compared to the 10 states decoded by the SN7441AN. Figure 6 and Table I give the *general* decoding logic for all possible binary-coded-decimal states. Considerable simplification is possible if you have a good understanding of digital logic. For instance, the schematic of my unit shows the decoding function performed by one 3-input gate equivalent, three 2-input gates, and one 1-input gate.



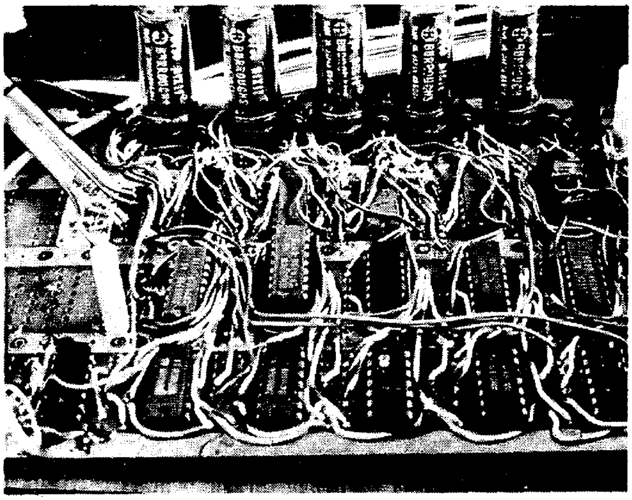
Top view of counting circuit.

If you wish, the unused states of the counter can be used to give an out-of-band indication (Fig. 7). None of the N outputs will be low if none of the proper states is decoded. This allows the transistor to be saturated. You can use it to light a light, ring a bell, disable the VOX circuit, or start a tape recording with hosannas to the FCC.

El Cheapo

Thus far, my comments have been about a "deluxe" counter with storage and 10 Hz readout. If you wish to build a more austere model (read "cheap"), there are ways to cut down on the cost. The best is to make a four-digit model with a 10 ms time base. Since the count interval is so short, you can sample once every tenth of a second, count for a hundredth of a second, perform housekeeping functions in 2.0 ms, and have a display visible for almost 90% of the time without using storage registers. One Nixie stage is eliminated, and IC6 is unnecessary.

To make the stripped-down version, substitute the circuitry of Fig. 8 for the bottom half of Fig. 2. It works as follows:



Rear view of counting circuit.

As the dividers count up from 0, the diodes decode a count of 88 and generate a 1 ms long reset pulse. At the transition to 90, the count gate decodes a binary 9 on the most significant digit and goes high for 10 ms, forming the gate interval. Thus, the SN7490s essentially perform the timing functions.

An additional Nixie stage can be eliminated by deleting the most significant digit from the count chain. This also saves the trouble of figuring out the decoding circuitry. Since any vfo will be accurate to the nearest 100 kHz, a second of mental work will compute the correct number.

Construction

Unless you want to make a PC board, the easiest way to build the unit is to use a "universal" IC card. The ICs and the Nixies can be mounted on it, and no drilling is required. Since most of the wiring is repetitive, it can be accomplished quite rapidly. The counter board will take about 4 hours, the timing board about 2. Looking at the photographs you may disbelieve me, but it goes very fast.

One suggestion to speed things up is to use the wire that can be found in multiconductor telephone cable. A four foot scrap of this stuff has 200 ft of hookup wire in it, and the wire has a soft plastic insulation which is very easy to strip. It melts at a low temperature, but since you're using a low power soldering iron, there should be no problem.

The crystal oscillator is quite stable, but it can obviously be improved by installing the crystal in an oven. The TTL circuits used in this project are much better than RTL with regard to noise immunity. A significant amount of rf can be floating around before erratic operation occurs. However, it is recommended that the unit be carefully bypassed and shielded; first, because often there *is* a considerable amount of rf floating around, and, secondly, because the pulses in the digital circuitry are very fast and can radiate noise to the receiver.

Mechanically, my unit was constructed on two boards which were then sandwiched together. This saved about 10 sq in. There is no reason why the unit can't be built on one board. Final dimensions exclusive of case were 5 by 4-1/2 by 2-1/4 in. Something this size could probably be installed inside the cabinet of the rig. If you wish, the Nixies and their drivers can be placed on a separate board which should easily fit in the space taken by the typical dial drum or scale assembly.

The unit requires 5V and some convenient high voltage. I described the B+ "supply" earlier. The 5V supply is worth a few words. Regulation is not critical, but if the supply has lots of hum or noise, filter it

TABLE I.

Connection Chart for all Binary Combinations

N=	BINARY	CONNECT A	CONNECT B	CONNECT C	CONNECT D
0	0000	$\overline{2^0}$	$\overline{2^1}$	$\overline{2^2}$	$\overline{2^3}$
1	1000	2^0	$\overline{2^1}$	$\overline{2^2}$	$\overline{2^3}$
2	0100	$\overline{2^0}$	2^1	$\overline{2^2}$	$\overline{2^3}$
3	1100	2^0	2^1	$\overline{2^2}$	$\overline{2^3}$
4	0010	$\overline{2^0}$	$\overline{2^1}$	2^2	$\overline{2^3}$
5	1010	2^0	$\overline{2^1}$	2^2	$\overline{2^3}$
6	0110	$\overline{2^0}$	2^1	2^2	$\overline{2^3}$
7	1110	2^0	2^1	2^2	$\overline{2^3}$
8	0001	$\overline{2^0}$	$\overline{2^1}$	$\overline{2^2}$	2^3
9	1001	2^0	$\overline{2^1}$	$\overline{2^2}$	2^3

out before it gets to the oscillator. The oscillator only takes 5 mA or so and an RC filter should be sufficient.

I used some nondescript power transistor for the series regulator. Anything that can handle an amp and 5W of dissipation should be sufficient.

The resistor shown bridging the transistor bypasses some of the current without, theoretically, greatly affecting the regulation. Measure the voltage across the transistor – there should be a large ac component. Pick a value for the resistor so that when the voltage is at an instantaneous minimum, the current through the resistor is about 100 mA. If all this is too much trouble, don't bother. Almost any transistor you choose can handle the power even without the resistor.

Final Thoughts

I have described a fairly simple and relatively cheap way of obtaining accurate frequency calibration. There are some inherent limitations. The main limitation is that the counter doesn't actually measure the transmitter output frequency. Since the assorted conversion oscillators are inevitably crystal-controlled, there is little cause to worry about significant errors. When you install the unit, it might be a good idea to set the vfo at 000.00 and zero-beat the transmitter output with your calibrator by adjusting the trimmer capacitors on the conversion crystals.

If you can't build the counter described because your rig doesn't fit the criteria, there is still hope. For instance, if it is additive and subtractive, you might consider using the bidirectional counters that are now available. Direction of count can be controlled by the band switch. These units are presently more expensive than the 7490s.

If your rig uses some odd vfo frequency, perhaps with a 455 kHz added or subtracted, you can try several things. One is to mix the vfo with a signal that will subtract the odd number. Another is to preset the counter with the reciprocal of the odd number and set to 9 all digits more significant than the odd number. I don't know how well these ideas will work, since it was not necessary to try them, but they seem to be theoretically sound. The reference gives a design for a more elaborate counter that might solve your problem.

If you feel as I do, that electronic equipment should have uses comprehensible to the layman, witness an additional characteristic of the digital dial. Take vfo knob firmly in hand and give it a spin. The last two digits of the display will be random numbers! Not wishing to become an accessory before the fact, I won't attempt to suggest what you might use those random numbers for, except perhaps compiling a random number table. But that shouldn't stop you from thinking . . .

...WA2IKL■

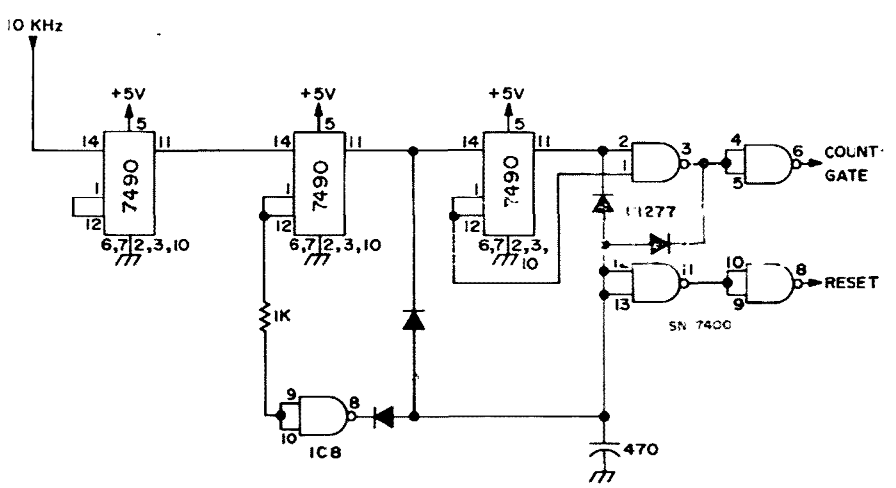
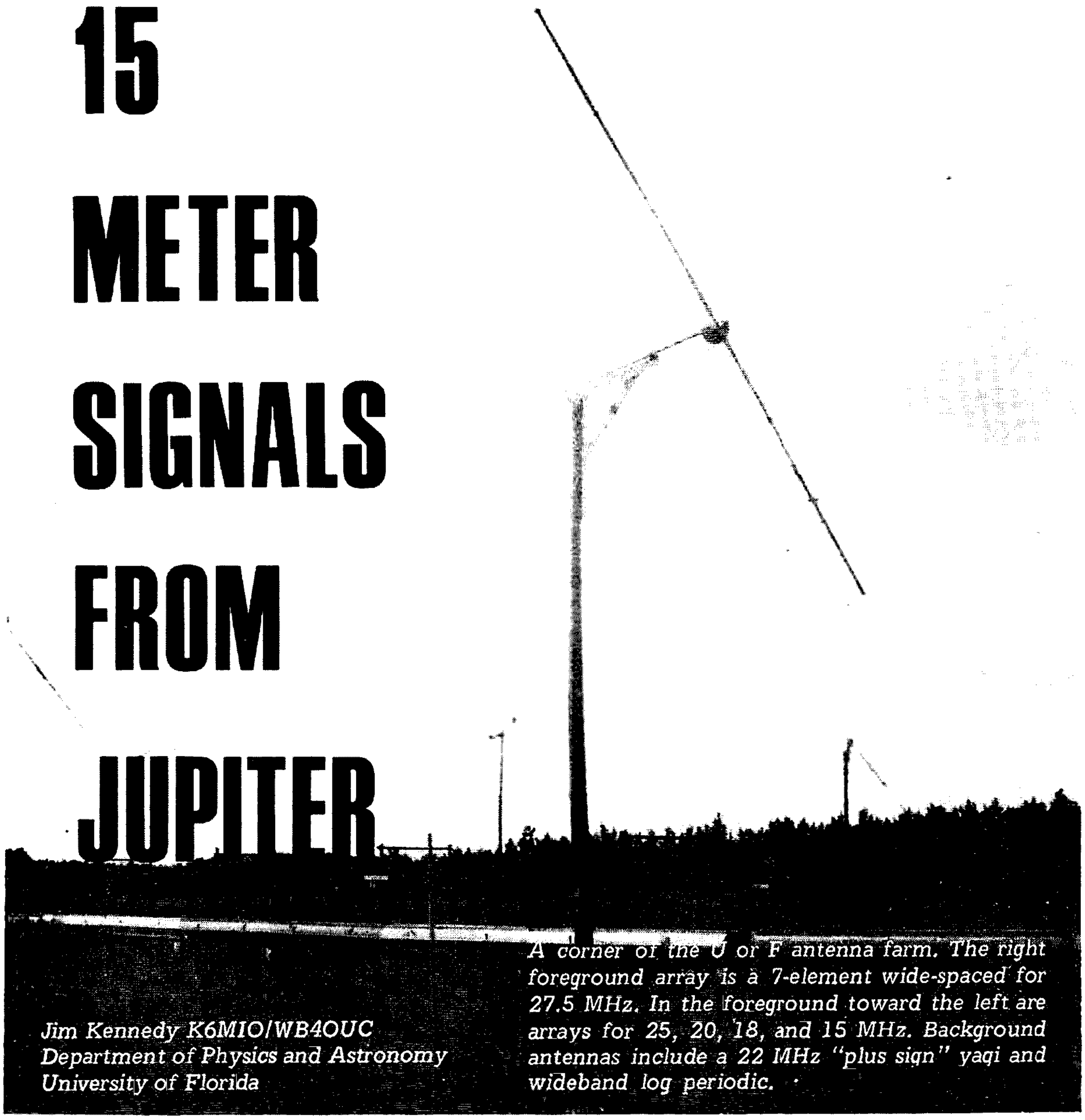


Fig. 8. By substituting this circuit for the bottom half of Fig. 2, a cheaper but less accurate digital counter results.

Ref. Macleish, Kenneth, "A Frequency Counter For the Amateur Station," QST, October 1970, pp.15.

15 METER SIGNALS FROM JUPITER



Jim Kennedy K6MIO/WB4OUC
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University of Florida

A corner of the U of F antenna farm. The right foreground array is a 7-element wide-spaced for 27.5 MHz. In the foreground toward the left are arrays for 25, 20, 18, and 15 MHz. Background antennas include a 22 MHz "plus sign" yagi and wideband log periodic.

At a time when the words "radio astronomy" conjure up pictures of gigantic parabolics and complex UHF feeds, it is a curious fact that one of the longest standing unsolved riddles in this field is commonly studied with a simple HF yagi.

The story of this puzzle begins in 1955 when two astronomers, K. L. Franklin and Bernard Burke, were testing a new 22 MHz radio telescope. Quite unexpectedly, they discovered that powerful sporadic radio emissions were being received from the vicinity of the planet Jupiter.

Jupiter is the largest of the planets in our solar system. This giant has a diameter of more than 12 times that of the earth and it is so massive that it is believed by some astrophysicists that it just missed becoming a true *star.* Its surface is shrouded by layers of clouds beyond which lie some 12 known moons. The four largest of these moons are bright enough to be seen with a good pair of binoculars. In fact, they were discovered by Galileo the first time he turned his primitive telescope on this bright object.

In the years since the initial discovery of these radio signals, investigations have led to a number of interesting discoveries.

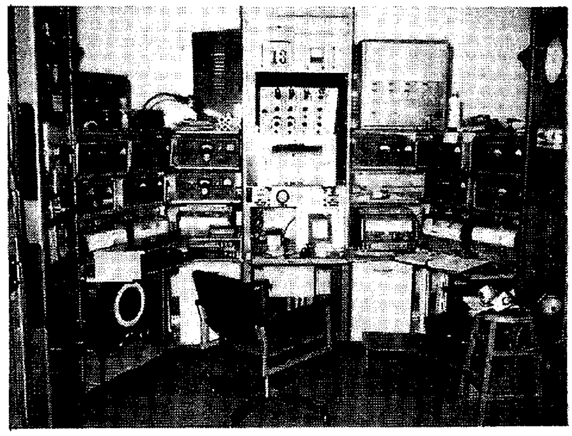
Among these are that the emissions are essentially confined to a region below 30 MHz. That is, to the region covered by most conventional communications receivers.

The energy contained in these bursts of activity is so enormous that they can be readily received by a three-element yagi and a conventional receiver.

The bandwidth of these signals is relatively narrow, sometimes no wider than 300 kHz. Such an effect definitely suggests some kind of resonance effect is associated with the generation of these signals. When observed, these signals may appear on one frequency and then gradually drift in frequency either up or down for several megahertz and then disappear.

It seems positively established that the lower the frequency, the greater are both the signal strength and the probability of occurrence.

When heard with an AM detector the Jupiter or "Jovian" signals sound very much like an unmodulated carrier being swished back and forth across the frequency. Interspersed with the swishes are shorter pops. The swishes, which last on the order of a second or so, are sometimes called L (for "long") bursts. The L bursts, as shown in Fig. 1, are thought to be produced by scintillation or "twinkling" of even longer pulses. This twinkling is caused by the clouds of electrons that flow out from the sun and into the space between the earth and Jupiter through which the signals travel.



Main operating position at the U of F Jupiter radio observatory. Note the 75S-1s.

The pops are often called S (for "short") bursts. These appear to be caused by some mechanism at the source and their explanation may well be an important clue to the cause of Jovian emissions.

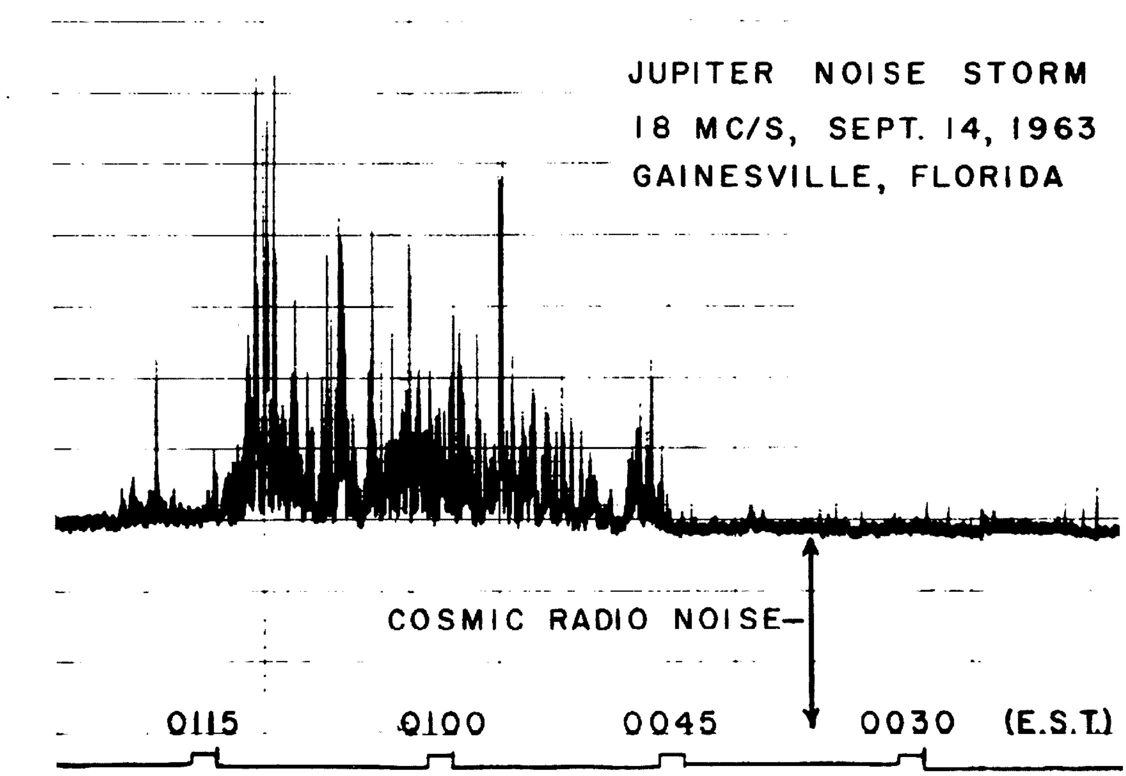


Fig. 1. Typical pen-recorder tracings of Jovian signals.

Directional Beams

Another most curious effect is that the signals seem to be directional in nature. That is, it appears as if the radiation is confined to beams about 70° wide and originate from specific confined areas of the planet. Observations indicate that the emissions observed are originating from no more than three or perhaps four locations which rotate with the giant planet. Radiation is detected only when those regions of the planet face the earth. Measurements made by two different techniques suggest that the source size has an *upper limit* of 400 km, and may be as small as 3 km.

Narrow bandwidth, directional beams, and fixed localized and limited sources quite naturally lead to the speculation that the signals may be the result of some "intelligent" activity. However, partial explanations for these effects, based on *natural* occurrences, exist and it seems probable that further investigation will, in time, complete this picture.

Figure 2 shows a diagram of storm occurrences as a function of longitude for the rotating planet. It will be noted that three or perhaps four distinct sources, labeled A, B, and C are present.

The explanation of the discrete source locations may lie in the supposed existence of short variations or "glitches" in the planet's magnetic field. Such anomalies are known to exist in the earth's field and can be supposed to exist on Jupiter.

Such glitches would be fixed in the planet's field and rotate with the planet.

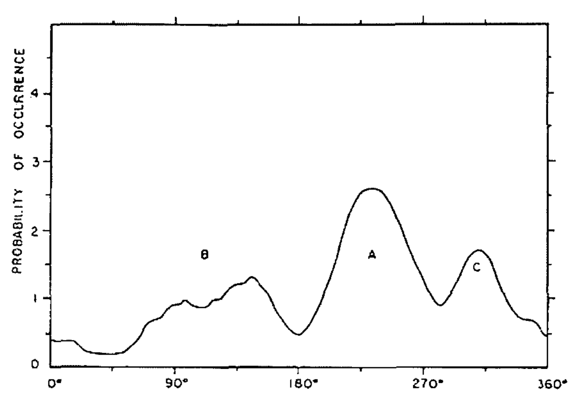


Fig. 2. A plot of the probability of noise storm occurrence versus Jovian longitude illustrating sources A, B, and C distributed around the planet.

They could provide a collecting place for electrons at some level in the magnetosphere and perhaps provide a site at which some mechanism would excite these electrons into oscillation.

Another more recent explanation suggests that the sources are caused by fast electrons following the magnetic field lines into the upper atmosphere near the north and south poles. These electrons would radiate in cone-shaped beams. Due to the fact that the magnetic poles of Jupiter are inclined some 10° to its rotation axis. This combination leads to the beams only being aimed at the earth during times of Jupiter's 10-hour day. This gives rise to the appearance of several sources while there may be as few as two. In a general way this process bears some similarity to that which produces *aurora* here on earth. No matter which of the many explanations is correct, the combination of electrons and magnetic field would provide the necessary (gyromagnetic or synchroton) resonance effect for the narrow bandwidth emissions, but not necessarily the *energy* to produce oscillation.

Just what source of driving energy does produce the oscillations? In the beginning it was thought that the radiation may have been caused by lightning strikes on the planet. However, measurements of the energy received here on earth indicate that the energy of the Jupiter "noise storm" bursts is approximately 10^{11} times that of an earthly lightning bolt! Hence this explanation seems *inadequate*.

The Io Effect

Adding to the confusion about the source mechanism is the more recently discovered Io effect. Io is the innermost of the four large satellites discovered by Galileo and is slightly smaller than our own moon.

It has been found that a significant number of the noise storms occur when Io is in certain preferred positions with respect to the various source locations. Hence, while storms *may* occur at any time one of the sources faces the earth, somehow Io enhances the probability of a storm considerably. Figure 3 illustrates that when

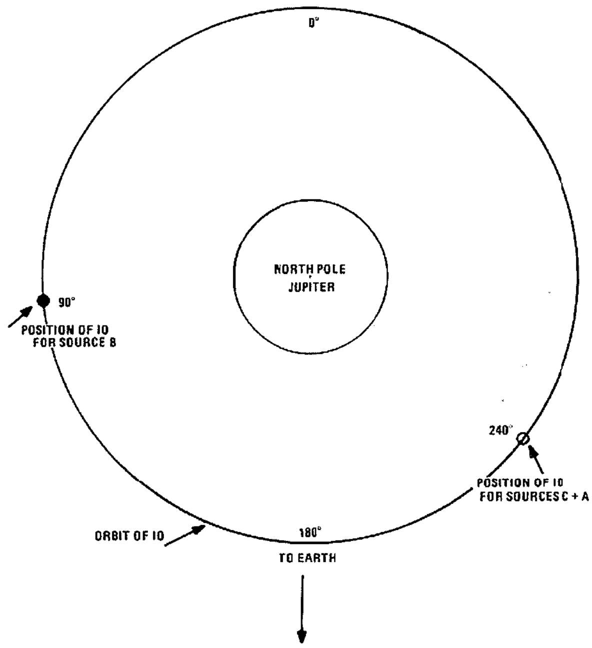


Fig. 3. This illustration shows the positions of Io which appear to trigger source B and source C and A storms.

Io is at a position of 90° from directly behind Jupiter, source B is most likely to produce storms. In fact, as high as 98% of all source B storms occur when Io is near this location. Likewise, when Io is at an angle of 240° source C and sometimes source A are likely to be active. Of course, not only must Io be in one of these "special" positions, but simultaneously, the appropriate source must be aimed at the earth.

One theory, called the "dynamo hypothesis," holds that this moon, oribiting well within the strong magnetosphere at about 280,000 miles, conducts electricity well enough to interact with the rotating magnetic field of the planet to form a giant electrical generator. If this were so, in certain positions it could pump the large numbers of energetic electrons along the magnetic lines into the polar zones to cause the noise storms.

A full understanding of how this comes about will undoubtedly aid significantly in solving the basic problem of why the storms occur at all. In the meantime the Io effect provides a convenient way of actually producing fairly accurate predictions of when noise storms will occur.

Receiving the Noise Storms

Receiving signals from beyond our own ionosphere presents problems of its own. The same electrons that reflect 21 MHz signals back to earth and provide skip, also reflect away incoming signals from beyond. Consequently one must observe at times when the ionosphere is "transparent." This is to say, one must, in general, listen at night.

This all adds somewhat to the complexity of things since it requires that Jupiter be *up* at night. Therefore, it is only possible to listen for Jovian signals for about six to eight months of the year. The 1970–1971 "apparition" began about December 1970 and will end about July 1971.

Receiving these storms is well within the capabilities of any amateur who has three or more elements on 15 meters. This, in combination with any decent communications receiver will produce excellent results.

The only difficulty is that most tribanders do not point up (except perhaps after a high wind!). Depending on the time of night Jupiter may be found as high as 40° or so above the horizon. Two general solutions exist for this problem. One approach would be to arrange to tilt the antenna. This can often be done with a small yagi by modifying the mounting bracket and using a simple system of ropes to tilt the antenna, while using the rotator, as before, to change the azimuth. (It might be added that such "haywire" systems are still used occasionally by "professionals" today.)

The second solution is to do *nothing* All earthbound horizon-aimed antennas have at least one, usually many lobes aimed high in the sky, due to ground reflection. Hence, if the antenna is pointed at the same azimuth as Jupiter, there is a fair chance that half the time Jupiter will be in one of these lobes. Needless to say, however, the former system is more certain than the latter.

While Jupiter does not radiate at 21 MHz continuously, the Io effect permits fairly good predictions to be made.

Since some storms occur without correlation to the Io effect, it is also possible to observe Jovian activity on other than the predicted nights.

One should be careful not to confuse lightning discharges with Jupiter. The raspy crash of lightning is quite different than the rounded swishing of Jovian signals. Those living in areas of high electrical activity (such as here in Florida) will hear a good deal more lightning than Jupiter. Likewise, in the early evening or toward sunrise, those within skip distance of such an area may also experience activity of this sort. Occasionally, if sporadic E is present, skipped lightning may occur at any time of night.

Despite the very great similarity between Jovian signals and that of a carrier being swished across the frequency (when you use an *AM* detector), this is only an illusion. If you use a product detector, do *not* expect to hear a carrier going back and forth through zero beat. Both cases will yield only a strong rise in the noise that *sounds* like a carrier on an AM detector.

The interested reader who wishes to pursue the matter of theory and previous observations further will find, in Radio Exploration of the Planetary System,[1] an interesting and very readable account of the Jupiter story. At a somewhat higher level, the article "The Magnetosphere of Jupiter,"[2] available through most college libraries, provides an up-to-date review of current work.

The author wishes to thank Drs. Alex Smith and George Lebo and their associates at the University of Florida for providing the data in Figs. 1 and 2.

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References:
1. A. G. Smith and T. D. Carr, 1964, *Radio Exploration of the Planetary System*, (D. Van Nostrand Company, Inc., Princeton, N.J.).
2. T. D. Carr and S. Gulkis, 1969, *Ann Rev. Astron, and Astrophys*, v. 7.

GENERAL CLASS LICENSE STUDY GUIDE

Part XI Antennas

One item which every radio station, be it for two-way communications or merely a listening post, has in common is the antenna. By definition, the antenna is the part of an installation which couples the transmitter or receiver to that little-understood medium in which radio signals travel, so without one neither transmission nor reception could be possible.

Because of its central importance, the antenna is involved in a number of questions in the FCC examination for the General class ticket. Let's look at some of these questions dealing with antennas and closely related subjects.

The FCC study list questions include:

13. Define standing wave ratio (swr). How can the swr of a line be determined? How are the swr of a line and its characteristic impedance related? Name some factors that affect the characteristic impedance of an air-insulated parallel-conductor transmission line?

21. List several characteristics of a vertical quarter-wavelength antenna.

41. How is the approximate length of a half-wave dipole related to the resonant frequency? Compare the operating characteristics of a half-wave dipole and a grounded antenna.

43. How can amateur equipment be protected from lightning discharge?

49. Briefly discuss how a multiband "trap" antenna operates.

Since these questions cover not only antenna operation and characteristics, but those of antenna feedlines as well, we're going to have to look at everything between the transmitter output connector and the input connector of the distant receiver to get a full grasp of them.

We'll begin by trying to determine "How do antennas operate?" If we get around that one (and several very thick books have been written on the subject; hopefully, we'll take far fewer words and not leave you nearly so confused), we'll continue by asking, "What major kinds of antennas exist?"

From there, we'll shift our attention to the feedline and inquire "What's impedance in antennas and feedlines?" Finally, we'll get around to that perennial conversation-piece swr with our last question, "What does swr do for you?"

It's a big assignment. Let's get moving.

How Do Antennas Operate?

In the beginning of this study course we made the acquaintance of the electric and magnetic fields which are inseparably associated with the flow of electrical current or the motion of a magnetized object. At that time, we observed that while the electric and magnetic fields were alternately swapping their energy content to provide motion of the current, some of the energy was lost to the mysterious surrounding medium, and this loss was known as "radiation."

An antenna is simply a device intended to make this "loss" of electromagnetic energy easy; its whole purpose is to couple energy from a normal wire conductor into space, or from space back into a normal conductor.

Since any flow of current within a conductor involves at least some radiation, almost any conducting material must act as an antenna of sorts, coupling energy into space and vice versa. That's why portable radios operate so well with self-contained

antennas. They have high sensitivity, and the tiny internal antennas extract enough energy from the powerful broadcast station signals to do a good enough job.

Virtually all ham antennas, though, are conducting surfaces which are large in comparison with the wavelength involved. When the conductor is long in comparison to the wavelength, the field strength at any one point on it will not be balanced out by similar strengths at many other nearby points. Instead, the strength of both the electric and the magnetic field around any one point on the conductor will vary, and the strength from one point to another will vary depending upon the distance between the points.

To see how this works, let's look first at a half-wave dipole antenna which is fed at its center. This antenna (Fig. 11-1) is one of the most commonly used varieties, and is also one of the easiest to visualize in operation.

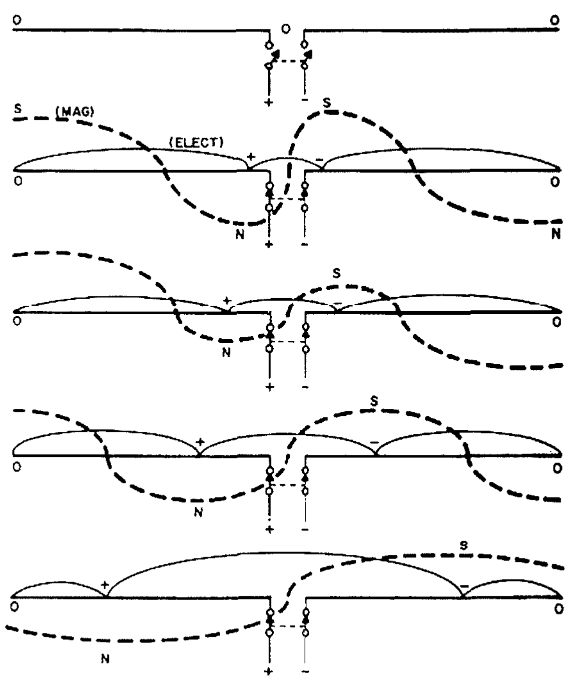

Fig. 11-1. Half-wave dipole provides example of how resonant antenna operates. At top antenna is disconnected from any energy source and so is inactive. When energy is supplied, fields begin to travel toward tips of antenna. As they travel, radio waves are emitted into space. Each cycle of RF repeats this action to provide continuous radiation.

First, let's assume that we have neither voltage nor current associated with the antenna. With no voltage, there's no electric field, and without current, no magnetic field. The antenna is just so much wire, hanging in the breeze.

Now let's apply a voltage suddenly at the feedpoint, say 100V between the wires. That would be +50V to one wire and -50V to the other, for instance.

These voltages cannot appear instantly at the ends. Instead, they must travel along the wire (at approximately the speed of light) to get there.

At each instant during this rather brief trip, there's a point on one wire at which voltage is just changing from 0 to +50V, and a corresponding point on the other at which it's just going from 0 to -50V. As the "wavefront" moves toward the ends of the antenna, these two points are getting farther apart from each other.

Since these two points are at different voltages, an electric field will exist between them. And since they're moving away from each other, the field is expanding rapidly. The energy which enables this field to expand is extracted from that which we fed into the wires to cause the initial change.

But whenever an electric field moves, a magnetic field moves right along with it. That voltage change involved a current flow, and the current flow is greatest back at the feedpoint because that's where all the energy must pass.

Eventually (rather rapidly, in fact) the voltage change reaches the ends of the antennas. Now it has no place to go. The field, however, is expanded to a large region, and contains a surprisingly large amount of stored energy which has to go someplace.

When the voltage stops moving, the current through the feedpoint stops also. The associated magnetic field collapses (because motion stopped). Thus, when the electric field is at its strongest, the magnetic field is at zero, which establishes a 90-degree-out-of-phase relationship between the fields and imparts outward motion to the resulting radio wave.

When the magnetic field collapses, nothing remains to hold the electric field stretched, and it also collapses. The voltages rush back down the elements toward the feedpoint. Since they're now going the other direction, their polarities are reversed, and when they get back to the feedpoint the electric field is back to zero while the magnetic field is at maximum.

If we do this with dc, as we did in this example, everything will stabilize after a few such cycles. The fields will carry away any transient energy, and when the full length of the antenna reaches a steady state, radiation will cease.

However, if instead of dc at the feedpoint, we apply ac, and adjust the frequency of this ac so that each time a reflected wavefront comes back from the tips of the antenna elements, it finds a new "push" just ready for it to send it on its outward path again, then we have a radiating device par excellence. It will accept just enough energy from the feedpoint to balance out that which it "loses" to space, and thus maintain what is known as a "standing wave" of rf energy on the antenna. During each cycle of applied rf, this standing wave will launch an infinite number of traveling radio waves into space.

In practice, we cannot adjust the frequency to suit our antenna, because ham frequencies are assigned within relatively narrow bands by the FCC. What we do instead is to adjust our antenna length to fit the frequency at which we desire to operate.

Frequency and wavelength are closely related, since frequency is the number of complete cycles which occur in a specified period of time, and wavelength is the distance between corresponding points of two successive cycles. The speed at which radiation travels is the relating element; wavelength is equal to speed of travel divided by frequency. If wavelength is in meters and frequency in megahertz, the formula comes out to be $\lambda = 300/f$.

The half-wave antenna we've been using as an example, then, should have a length approximately half of one wavelength. To operate at 7 MHz, its length should be about 22½ meters.

This relationship is only approximate, though, because every antenna has some capacitance to ground, which makes it appear to be a little longer (to the fields) than it really is. The difference usually amounts to about 5%; the formula usually used to determine length of a "half-wave" antenna takes this into account, and also comes out in feet rather than meters. It's: length = 468/f, where f is frequency in MHz.

Figure 11-2 shows what happens when an antenna is either too short or too long

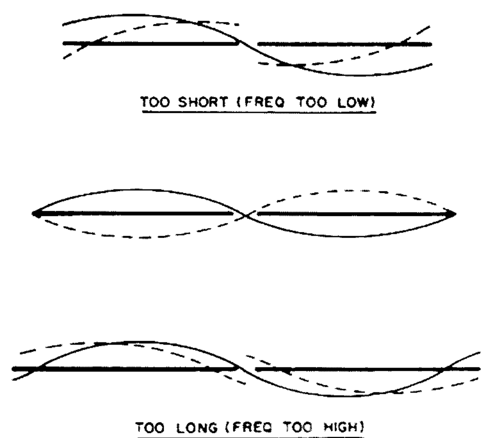

Fig. 11-2. When antenna is too short for operating frequency, reflected electric field is out of phase with driving energy (top) and part of driving energy is cancelled. If antenna is too long for frequency (bottom), same thing happens in reversed phase. Only if antenna length and operating frequency match (center) does all energy radiate, and antenna's impedance has no reactive component.

for the operating frequency, as well as the desired result when the length and frequency match.

However, one-half wavelength is not the only practical length for antennas. Almost any multiple of quarter-wavelengths (with the 5% correction factor applied to the one at the far end, only) can be used. Such antennas are sometimes called "long-wire" antennas, although some hams use the term "long wire" for a random-length antenna which operates in spite of rather than because of its length.

Any antenna has two characteristics by which its performance can be measured, and a third which is essential to making use

of it. The "rating" characteristics are its directional pattern or *directivity*, and its *efficiency*, and the third characteristic is its *impedance*. We'll examine impedance later. Right now let's take up directivity.

When the antenna launches its radio waves into space, each tiny part of the conductor launches its own collection of rays. That is, each infinitesimal portion of the antenna acts like a tiny isolated antenna, and each radiates its energy equally in all directions like an expanding sphere.

In some directions, however, the traveling waves from various parts of the overall antenna structure has phase relationships which cause them to cancel each other, while in other directions these phase relationships cause the individual rays to reinforce each other and build up added strength.

For the half-wave dipole, the resulitng pattern of "far-field signal intensity" is something like a donut strung on the antenna wire (Fig. 11-3), with the strongest part of the pattern at right angles to the wire itself, and no field strength at all off either end.

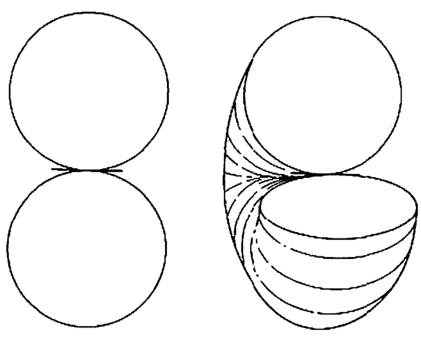

Fig. 11-3. Radiation pattern of half-wave dipole is shown here both in cross-section (left) as generally drawn in pattern diagrams, and three-dimensionally (right). Resemblance to donut strung on wire is easy to see. This pattern occurs only if antenna is in "free space" with nothing affecting it, a condition which never actually occurs. Actual antennas are influenced by presence of ground, which reflects energy and modifies the radiation patterns.

Long wires modify this pattern to produce a cone of field strength (Fig. 11-4), aimed in the same general direction as the wire is pointing, but covering a region at an angle to the wire itself.

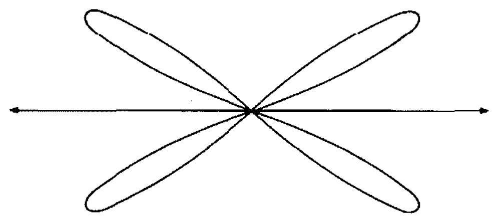

Fig. 11-4. Long-wire antenna's radiation pattern stretches the figure-8 pattern of dipole into pair of lobes. The longer the wire, the closer the lobes approach the wire direction. In 3 dimensions, pattern would resemble two cones, point-to-point, strung on wire.

Combinations of long wires can be put together as in the rhombic antenna (Fig. 11-5), to give almost no response at all except in the two directions in which all the combinations add together. Such antennas are favorites of commercial installations, as well as of those hams who can afford enough space to string them. Most of us, though, must settle for much less.

In fact, the differences between the various types of antennas are largely differences in directional patterns, or in different types of construction in order to achieve equivalent directional patterns.

The efficiency of an antenna is difficult to measure. In general, resonant antennas (those which are multiples of quarter wavelengths long) have the highest absolute efficiency, and directive antennas (those

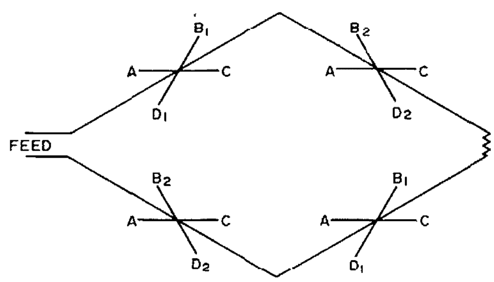

Fig. 11-5. Rhombic antenna is derived from long-wire (Fig. 11-4). Each leg of the rhombic has a long-wire pattern symbolized here by lines rather than lobes. Radiation arriving from left, however, goes to terminating resistor and does not affect feedline; thus lobes A, B2, and D1 have no effect on antenna operation. That arriving from right can reach feedline. Of this, only that in lobe C of each leg adds up. B1 lobes tend to cancel each other out, as do D2 lobes. Result is highly directional single-lobe pattern, but antenna is too large for most ham installations.

with sharp directional patterns which concentrate the radiated energy within relatively small volumes of space) have higher apparent efficiency than do nondirectional antennas. One rule of thumb left over from the earliest days still is surprisingly valid – the more wire, the better.

In addition to the characteristics of directivity, efficiency, and impedance, which we've mentioned, every antenna has one other characteristic called *polarization*.

While it's a bit hard to visualize clearly, every radio wave is composed of two related fields in motion – the *electric* field and the *magnetic* field. Each of these fields has its own plane, and the two planes cross each other at right angles to establish the line along which the wave travels. If it helps to think of the two walls of a room meeting at the corner to establish the position of the corner, do so.

The polarization of this radio wave is simply the direction in which the electric field's plane extends. If the electric-field plane is vertical, the wave is said to be vertically polarized, and if the electric-field plane is horizontal, the wave is horizontally polarized.

Since it's impossible to separate out a single radio wave in practice, a "vertical" or "horizontal" polarization of a signal must refer to the polarization of the majority of the individual waves which make up that signal. As a result, all actual signals contain portions of both polarizations. A "vertical" signal will have some horizontal components, and vice versa.

A signal which contains both vertical and horizontal components is known as an "elliptically" polarized signal, and if it has equal amounts of vertical and horizontal, we call it "circular" polarization.

What determines the polarization of a signal is the antenna that transmits it – but polarization of any individual wave will change every time that wave is reflected from anything on its path from transmitter to receiver.

The plane in which the transmitting antenna polarizes the signal is the same as that containing the wire of the antenna, for the most common antenna types. Thus, a horizontally stretched half-wave dipole will

transmit a horizontally polarized signal, while a vertical antenna will transmit a signal having vertical polarization.

If the signal is transmitted at the same time from two antennas, one vertical and one horizontal, the result is an elliptically polarized signal.

In the normal HF region (3 to 30 MHz), the polarization of the signal doesn't mean too much because most communications in these bands are by means of the ionized layers of the atmosphere, and the polarization is rotated when the signal reflects from these layers. At VHF, however, polarization is important. VHF work in this country now seems to be about equally divided between vertical and horizontal polarization. Elliptical polarization is seldom used except in the UHF regions and above, where the helical antennas which produce it most simply are small enough to be convenient.

Now that we have some ideas about how an antenna works in general, let's take a look at the various types of antennas in common use.

What Major Kinds of Antennas Exist?

Antennas are classified in many different ways. Some of them are named for the people who first popularized them, some are named for their major characteristics, and some have apparently arbitrary names.

The most general division of antennas breaks them into two groups: those which depend upon standing waves for their operation (as described in the previous section) and those which operate with traveling waves. Traveling-wave antennas are sometimes known as "terminated" antennas. Hams make very little use of this type, because at moderate frequencies they require excessive acreage, and at frequencies where their size is practical, they are outperformed by other types. The rhombic is virtually the only terminated antenna used by hams, and we won't go into any of the others in this group.

The antennas using standing waves can be subdivided again into those which are "resonant" and those which are not. A resonant antenna is one which is cut to a length which is a multiple of ¼ wavelength, or made to appear to be such a length by electrical tricks such as loading coils, capacitance, or tuned traps. Most ham antennas are resonant.

A nonresonant antenna is simply a random length of wire. Normally such an antenna does not operate well unless it's tuned by an antenna tuner, which turns it into a resonant antenna so far as the electrical properties are concerned.

Among resonant standing-wave antennas, though, there are still an amazing number of types to be examined.

The most common is the half-wave dipole which we used to examine antenna operation. In its purest form, this consists of a length of wire one-half wavelength from end to end (less the correction factor we mentioned before, for end capacitance), with an insulator in the middle. This divides the antenna, both physically and electrically, into two equal quarter wavelengths of wire set end to end. These are fed with a "balanced signal" (one which is balanced with respect to ground, so that when the signal on one wire is at its positive peak that on the other is at negative peak).

The dipole continues to be a good performer even when its two wires are not stretched in a straight line. Such variants have many names.

For instance, the popular "inverted vee" antenna is merely a half-wave dipole suspended from a single pole at the center, with the ends allowed to droop down to much shorter supports. Its behavior is much the same as that of the dipole.

A half-wave dipole performs well not only at its fundamental frequency but at the third harmonic of this frequency, where each wire is ¾ wave long instead of ¼ wave. That is, a dipole cut for 7 MHz also does well at 21 MHz.

However, at even harmonics the dipole does not do so well. The feedpoint imped ance becomes high rather than low (voltage fed rather than current fed). And most ham bands are in an even-harmonic relation to each other.

Operators who want to use all bands thus find themselves in need of several

antennas if they intend to use the dipole. One solution to the problem which finds wide use is to place all the antennas together (Fig. 11-6). This is sometimes called a "parallel dipole" antenna. Only the pair of conductors which are resonant at the particular frequency in use are effective, and they operate as a half-wave dipole. The rest of the conductors merely go along for the ride.

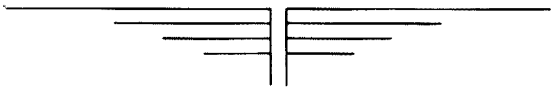

Fig. 11-6. Parallel-dipole antenna consists of several half-wave dipoles all strung together and connected at feedpoint. Only that which is resonant in any band is effective; rest disconnect themselves.

Another solution to the problem is the "trap" antenna. This is essentially a half-wave dipole for the lowest frequency to be used, with tuned parallel-resonant "traps" inserted in the wires. At the lowest frequency, the trap circuits show up as inductance which electrically lengthens the wire, so that the physical length of the antenna is less than its electrical length. At the next higher band, the outermost traps are resonant and effectively disconnect the ends of the wire, leaving a half-wave dipole for the higher frequency. In a 5-band trap antenna (Fig. 11-7), this dipole also is loaded by the inner traps.

At the next higher band, the next set of traps is resonant and so cuts off all the ends (including the outer traps). The fourth band of the 5-band trap is 21 MHz, which takes advantage of the third-harmonic operation and uses the 7 MHz dipole. Finally at the highest band, the

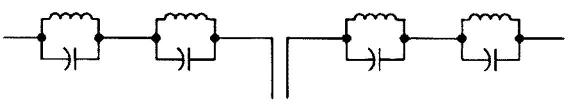

Fig. 11-7. Trap dipole makes use of parallel-resonant "trap" circuits in wire to alter length of antenna depending upon frequency. See text for explanation of antenna's action.

innermost traps isolate the outer portions of the antenna to again produce a half-wave dipole.

The trap antenna is a bit more difficult to adjust properly than is the parallel dipole, because the wire length, trap inductance, and trap capacitance all interact with each other at every operating frequency. However, these multiple interactions permit fine adjustments which permit improved performance if you have enough patience.

Still another solution to the all-band antenna situation is the Windom antenna. The Windom is a pseudo-balanced antenna similar in appearance to a half-wave dipole, but with the two conductors being of unequal length. This raises the feedpoint impedance to approximately 300Ω, permitting use of common TV twinlead. Interaction between the shorter wire and the longer wire permits resonance on several ham bands simultaneously.

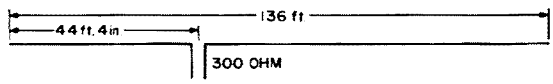

Fig. 11-8. "Windom" antenna provides match for 300Ω feedline and has been popular since mid-1930's. Dimensions are critical in order to approximate 300Ω impedance at feedpoint on all hf ham bands.

The "L" antenna is similar to the Windom, but the two legs of the antenna extend at right angle to each other rather than in a straight line. This tends to broaden the directional pattern in comparison to the two-lobed effect common to almost all dipoles.

All of the antennas we've examined so far have been of the "balanced" variety, which are normally stretched in the horizontal plane and so produce horizontally polarized signals (they don't have to be; at higher frequencies vertical dipoles are often used).

However, radio waves will reflect from any conducting surface, and the reflection produces the same effect as a mirror does for light rays. That is, if a half-wave dipole were to be cut in two at its midpoint and a

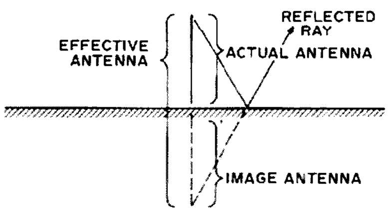

Fig. 11-9. "Image" principle is key to operation of quarter-wave vertical antenna. Reflected ray shown actually originates at tip of actual antenna, but apparently originates at tip of "image" antenna beneath ground surface. Effectively, then, antenna is a half-wave dipole standing on end, while actual structure is only quarter-wave high.

huge reflector properly placed (Fig. 11-9), the effect would be the same as if the other half of the dipole (the "image" antenna) were actually still present.

This is the basis for the quarter-wave grounded antennas often known as "Marconi" antennas. They are, in effect, half of a half-wave dipole, using the ground as the reflector to provide the "image" of the rest of the antenna.

Such an antenna must be vertical in order to use the ground as the reflector, and so this type of antenna is often called simply the "vertical" antenna.

Traps can be used in a vertical, for the same effects obtained in a trap dipole. Similarly, several verticals can be erected in parallel with each other and sharing a common feedpoint to produce an all-band vertical operating much like the parallel dipole.

The major differences between the vertical and the dipole stem from the different orientation. Where the directional pattern of the dipole (on the earth's surface) has two lobes of major response, with nulls off the ends of the wire, the vertical is omnidirectional. Its single null is off the end of the wire still, but now that points straight up. The three-dimensional directional pattern is still the same, but since it intersects the earth's surface differently, the practical effects are greatly changed.

The second major difference comes from the change from balanced (two-wire) to unbalanced (one wire against ground) operation. This changes the feedpoint impedance and the type of feedline required.

It may seem as if we've omitted several common antenna types from this listing. For instance, we have not yet mentioned the folded dipole or the monopole. However, while these are often spoken of as if they were distinct antenna types, they are in fact only variations of other types which we have already described, which have different impedances. We'll get to them in the next section.

So far we've discussed only the simpler types of antennas. Long ago people found that the directional properties of an antenna could be modified by adding more antennas to it, forming an antenna array. The added antennas can be parallel to the original but separated by some fraction of a wavelength (broadside array), in a straight line with the original (collinear array), or a combination of these (Franklin array). The directivity can be controlled by proper phasing of currents in the individual elements of the array, to give broadside or end-fire patterns, or to vary the direction of maximum response (beam-steered array).

Most of the different antenna types used by hams at frequencies above 14 MHz involve some type of array. Among them are such designs as the "sterba curtain," the "ZL special," the "8JK," the "flattop," and so forth. A special group of array designs involves "parasitic" elements which are not driven by feedlines, but reradiate energy absorbed from that radiated from the driven element. The most common of these "beam" antennas is the yagi, but again many variations have been designed and each has its own name.

One of the more recent types of antenna arrays is the "log periodic" antenna, which involves exotic mathematics in its design. Such an antenna can cover a bandwidth of 10 to 1 while maintaining a good beam pattern and a low swr, but it's a bit beyond the scope of our discussion here.

When you reach the VHF bands, the number of antenna types takes another sudden jump. There you may encounter such things as the discone, the helical, or the rereflecting dish (parabolic antenna).

However, for the General class exam, it's enough to know the simpler types such as the dipole and the vertical, as well as having some idea of the different types in use. We've got enough for that now, so we'll continue and examine impedance and feedlines.

What's Impedance in Antennas and Feedlines?

Whenever you discuss antennas, you can't escape *impedance*. It's one of the major characteristics of any antenna, and of any line used to feed the antenna with energy. What we hope to do here is to clarify just what it amounts to, and why it's so important to antenna operation.

Back in one of the early chapters of this study course we made the acquaintance of impedance in its most general form, and discovered that impedance amounts to "any quantity measured in ohms" while the ohm is simply the ratio of voltage to current at any point in a circuit.

Since both voltage and current are present in an operating antenna at every point along the conductor, it's only natural that every point on an antenna should have an impedance of some type.

But because of the way in which an antenna operates, both the voltage and current are varying, and where voltage is high current is low and vice versa. Therefore the impedance must change from point to point along the antenna. Where voltage is high, so is the impedance; where voltage is low and current high, the impedance is low.

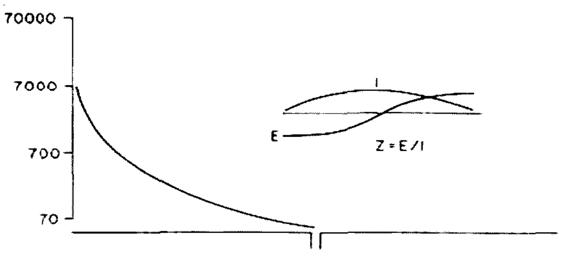

Fig. 11-10. Variation of impedance along half-wave dipole from center to ends is shown here. Impedance is ratio of voltage to current, both of which vary along antenna's length as shown in inset, and so ranges from very low at center to very high at ends. Because of radiation, impedance never reaches zero, but has minimum of about 70Ω for half-wave dipole in free space.

Figure 11-10 shows how impedance varies along a half-wave dipole. At the ends, it's very high (the capacitive "end effect" which makes it necessary to shorten the wire by 5% from an actual half wavelength keeps some current flowing even at the end, and so keeps impedance from becoming infinite). In the center, it is low.

You might expect the impedance to drop to zero at the center of an ideal dipole, but it doesn't, because the antenna is radiating power and so there's always a little more power going in than there is reflecting back from the ends. In "free space" separated from all other conductors, a dipole would have an impedance of about 73Ω at its center.

Any actual antenna's impedance will be modified by the energy which it receives from nearby reflecting surfaces such as the ground. Figure 11-11 shows how the impedance of a dipole varies because of this ground effect, assuming that the ground is a perfect reflector.

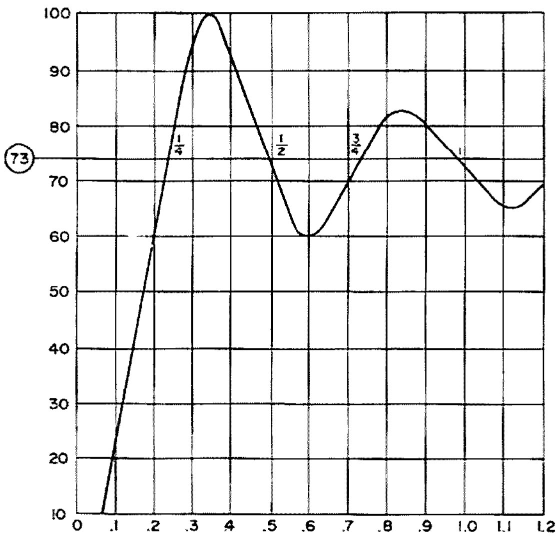

Fig. 11-11. Impedance of half-wave dipole illustrates action of reflected energy from ground in changing antenna's actual impedance. Vertical scale is impedance in ohms; horizontal is height above electrical ground in wavelengths. At multiples of one-quarter wave, conditions are similar to those of free space. At other distances, impedance may be higher or lower than anticipated value.

When several antennas are used together in an array (or when parasitic elements are placed near a driven element as in a yagi or other beam antenna), the power in each of them affects the power in each of the others – and so their impedances change.

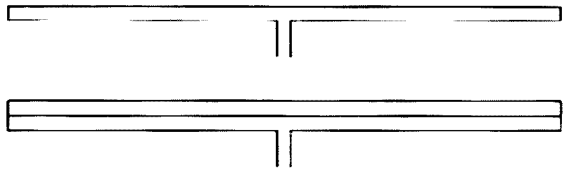

Fig. 11-12. Folded dipole multiplies antenna's impedance by providing alternate paths for current and so raising voltage-to-current ratio. Two-wire version (top) multiplies by 4; 3-wire version by 9.

Because impedance is a measure of the ratio of voltage to current, anything which modifies this ratio will change the impedance of an antenna. One of the most common modifications of this sort is the "folded dipole" antenna (Fig. 11-12). This is an ordinary half-wave dipole, with a second half-wave of wire strung alongside and connected to it at the ends. Now, when the voltage peaks reach the ends of the antenna and reflect back, they have not one but two paths available – one back down the original wire, and the other down the second wire alongside it. This splits the current between the two wires, and at the same time doubles the voltage for the same power (to keep power constant). The result is that the impedance is multipled by four, two times being for the doubling of voltage and the other two for the halving of current. A folded dipole then has about 300Ω feedpoint impedance in comparison with the ordinary dipole's 73Ω. This makes the folded dipole a nearly perfect match for 300Ω twinlead.

If the two conductors of the dipole are not of the same diameter, the current will divide according to the ratio of the diameters. If the driven half is only half as large a wire as the passive side, two-thirds of the current will flow in the driven portion assuming both halves are of the same material. To keep power constant, the voltages must change by the same ratio, so that at the feedpoint the current is one-third as great as in a plain dipole, and the voltage 3 times as large, giving an

impedance multiplication of 9 times or about 650Ω. This fact is often used in beam antennas for impedance matching, to raise the feedpoint impedance of the array up to something large enough to match conventional feedlines.

The "monopole" is simply the vertical version of the folded dipole, in which the passive conductor is grounded. It provides the same impedance-multiplying effect, for the same reasons.

What makes impedance so important in an antenna and feedline is the fact that rf energy flows smoothly only when the impedance of the circuit in which it is flowing does not change. In fact, the reason an antenna radiates is directly related to the fact that its impedance changes, as we saw earlier in this capter. So long as circuit impedance remains constant, the rf energy finds a "smooth" path to follow and like all kinds of energy, flows along the path of least resistance. When impedance changes, this produces a "hump" in the path, and energy goes in all directions. If the hump is small, most of the energy keeps going in its original direction, but some will be radiated and some will be reflected at any hump or discontinuity.

Now that we've seen what the impedance of an antenna amounts to, how about the feedline?

In general, feedlines (like antennas) can be divided into two major groups: balanced and unbalanced. 300Ω twinlead is an example of balanced feedline. Coaxial cable is an example of an unbalanced line. Just as with antennas, the "balance" is with respect to ground. In a balanced feedline, any voltage in one wire with respect to ground is "balanced out" by an equal voltage of opposite polarity in the other wire. In an unbalanced line, one conductor is always at ground potential and the other carries the full energy flow.

Most balanced feedlines are composed of two parallel conductors, and this type of line is often called parallel-conductor transmission line. It may, however, have more. In some commercial installations, four wires are used in a balanced configuration to carry higher power. 300Ω line is a parallel-conductor transmission line.

In a parallel-conductor line, the two conductors are kept a fixed distance apart by means of some type of insulating material. In the 300Ω line, the insulating material is typically polyethylene. At higher power levels, air is often the insulating medium. In an air-insulated parallel-conductor line, conductor spacing is fixed by means of insulating spreaders at regular intervals.

While both balanced and unbalanced feedlines have a "characteristic" impedance, it's easier to visualize in the case of the parallel conductor lines, and so we'll look at them first.

Whenever such a line is varying power, a voltage exists between the two conductors at all times, and current is flowing in each. Since every conductor has inductance, each of the line's two conductors will have inductance. Since the two conductors are separated by an insulating material, capacitance will exist between them. Both the inductance and the capacitance are "distributed" along the full length of the line rather than being "lumped" into separate inductors and capacitors. The inductance will restrict current flow, while the capacitance will inhibit voltage change. The net result of the inductance and capacitance is that each tiny incremental portion of the line is equivalent to the circuit shown in Fig. 11-13.

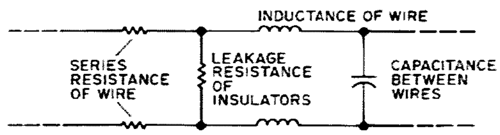

Fig. 11-13. Equivalent circuit of transmission line includes series resistance and inductance of each conductor, shunt resistance of insulators, and capacitance between wires. Inductance and capacitance here determine line's "characteristic impedance."

Since both resistance and reactance are present in this circuit, it must have some value of impedance associated with it. As it happens, the impedance turns out to be constant with frequency, and is equal to the square root of the ratio of inductance to capacitance.

The inductance is established by the diameter of the conductors, and the capacitance depends primarily upon the spacing between conductors (although the type of insulating material also has a major effect). The larger the conductor, the lower its inductance and therefore the smaller will be the line's characteristic impedance. Similarly, the closer together the two conductors are, the greater will be the capacitance, and again the value of the impedance will decrease.

The key point here is not so much the formula which determines impedance, because you can look that up in a handbook whenever you might need it (most of us purchase feedline ready-made, anyway). Rather, it's the fact that the characteristic impedance of a parallel-conductor line depends entirely upon physical factors: the diameters of the conductors, the spacing between conductors, and the type of insulating material.

In the balanced line, any radiation which might occur from one conductor is balanced out by equal and opposite radiation from the other, and so long as conductor spacing is very small (as compared to wavelength) the line has no effective radiation.

However, keeping such a line perfectly balanced is a bit tricky. Anything that might affect one conductor must be made to have exactly the same effect on the other. Because of this, a balanced line should be kept clear of all surrounding objects.

The coaxial line bears the same relationship to the balanced line as the vertical antenna does to the dipole. It's effectively just half of the balanced line.

Coax consists of a single conductor running down the middle of a hollow conducting tube. Both conductors share the same axis, and that's where the name "coaxial" comes from. Most commonly used coax consists of a center conductor surrounded by foam insulation, with a flexible metal shield braid providing the outer conductor, and the whole business enclosed in a weatherproof jacket.

In coax, the center conductor is free to radiate in all directions, but the outer shielding conductor confines all this radiation to the inside of the line. Thus such a line does not depend upon tricky balancing to prevent radiation, and can be run almost anywhere.

Like parallel-conductor line, coax has both inductance and capacitance along its length, and so has a value of characteristic impedance fixed by these L and C values. Again, the impedance of any line is fixed by physical factors: the diameter of conductor (inner conductor), spacing between conductors (ratio of conductor diameters), and insulating material between them. Most common coax has either 52 or 75Ω impedance.

Now that we've met impedance in both the antenna and the feedline, it's time to put the two together.

We've already observed that rf energy flows smoothly only when it encounters no "bumps" or impedance discontinuities in its path. Therefore, if both the antenna feedpoint and the feedline connected to it have exactly the same impedance, the energy cannot tell the difference between them. There will be no "bump" to cause reflection of energy, and everything will flow smoothly. Such a condition is known as a "match" because the impedances match perfectly, and that's the goal of most antenna and feedline adjustments.

Since antenna impedance depends upon so many variable factors, however, while feedline impedance is fixed by a few physical constants, the "matched" condition seldom happens by accident. If the impedance of the antenna feedpoint and the feedline differ, you have a mismatch which reflects energy back toward the transmitter. This mismatch creates a standing wave on the feedline in just the same way that the ends of the antenna create a standing wave on the antenna, and the feedline then can radiate energy – which is normally not a desirable situation, because this radiation may interfere with the desired pattern from the antenna.

In addition, the energy reflected down the line may cause the impedance at the transmitter end of the line to be either too high or too low for proper operation. That's why most hams strive to match their

antennas and feedlines.

Note that while a standing wave is necessary for operation of the antenna, it's not desirable on the feedline. In fact, the strength of the standing waves on the feedline (voltage standing wave ratio, often abbreviated merely swr) is used as a measure of antenna system performance.

What Does SWR Do For You?

We have now seen how a resonant antenna radiates energy by means of the standing wave of voltage and current created upon it, and we have seen that an impedance mismatch between feedline and antenna can cause a similar standing wave to be created upon the feedline.

This standing wave on the feedline is not considered to be desirable, because from an engineering standpoint any one part of a system should do only the job it's there to do, and not do the job of some other part. The purpose of the antenna is to radiate, that of the feedline is to carry the energy – all of the energy – from transmitter to antenna, and if the feedline does some of the antenna's job of radiating, this is not good.

Of course, you might connect the transmitter directly to the antenna with no intervening feedline, and that's exactly what connecting a random-length, nonresonant hunk of wire to a transmitter amounts to. If it's necessary to get a signal out at any cost, this is an acceptable solution, but the directive pattern of such an antenna is unknown, and transmitters sometimes turn out to be difficult to operate with six-inch arcs of rf energy leaping from every sharp corner! It's important to note clearly at this point that the existence of standing waves on the feedline will *not* make it impossible to radiate energy. They may make it impossible to get the energy out of the transmitter, by causing changes in effective feedline impedance, but that can be remedied by adjusting the legnth of the feedline. The primary purpose of getting a good match and resulting freedom from feedline standing waves is to let the antenna operate as it was designed to, and to prevent undesired radiation.

The most commonly used measure of feedline performance is the swr (or vswr). The term derives from the earliest means of measurement. You'll recall that the standing wave is essentially stationary; that is, on the antenna the voltage is always maximum at the ends and minimum in the middle (for the half-wave centerfed dipole we used as an example). It works the same way on the feedline. The standing wave on the feedline will produce a voltage max imum at some points, and at other points a quarter wavelength away from these maxima, voltage will be minimum. The swr is simply the ratio between the maximum rf voltage and the minimum.

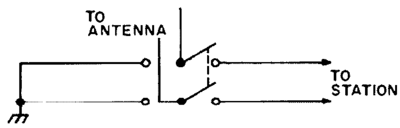

Fig. 11-14. Most certain protection for amateur equipment against danger of damage by lightning involves large DPDT switch connected as shown here, to remove antenna connections from station's equipment and connect antenna instead to ground by heavy, short leads. This effectively converts antenna installation into lightning rod structure. Even this, though, may not protect against a direct hit.

Thus, if there's no standing wave at all, the maximum and minimum will be the same, and the ratio will come out to be 1.0. Therefore an swr of 1 (or 1:1) means that no standing wave exists, and any *smaller* value is simply impossible, by definition.

If the standing wave were using all the energy in the feedline, the ratio would be nearly infinite, as it is on the antenna.

In practice, the swr usually ranges from 1.05 or so up to possibly 10. The higher the swr, the greater the magnitude of the standing wave on the feedline.

We saw earlier that the ratio of voltage to current created an impedance for the antenna, which varies as we move along the conductor. We also saw that the characteristic impedance of a feedline is determined by physical rather than electrical quantities.

The swr on a feedline modifies the *effective* impedance of that line, although its characteristic impedance remains unchanged. An swr of 2 means that the voltage swings through a 2-to-1 range of variation. The minimum will have only half the voltage that is present at a maximum.

Since with power remaining constant, voltage and current must have a constant product, the current goes through the same range of variation. This must, then, mean that effective impedance goes through a 4-to-1 variation. When current in the line is maximum and voltage minimum, impedance is minimum. When current is at its highest value and voltage at its lowest, impedance is maximum.

As it happens, this variation in effective impedance swings around the "characteristic impedance" as a center point. With 75Ω line and an swr of 2, the effective impedance would range from 37.5Ω minimum to 150Ω maximum. (Actually, since it's impedance, there's also a reactive component, but right now we'll ignore it. This is oversimplification, but with a purpose.)

If the swr were to climb to 10, then the impedance swing would be from 7.5Ω to 750Ω.

One of the effects of swr on a feedline, then, in addition to making possible unwanted radiation, is to make the effective impedance at the transmitter end of the line become something other than what you thought it was. This is what makes a line with high swr difficult to work with at times. Transmitters are designed to feed specified feedline impedances; if swr puts the actual effective impedance out of that range, things don't work right.

The multiplying effect upon voltage (maximum-voltage levels) is another problem of swr. It's easy for the voltage at a maximum to be greater than the feedline or the transmitter insulation is designed to handle. Even a 10W transmitter can develop quite respectable voltages when the impedance is high enough. Similarly, the current maximums may cause the feedline conductors to heat up enough to melt the insulation.

So now that we know some of the problems, what can we do about it?

The cause of standing waves on feedlines is, as we saw, the presence of impedance "humps" in the path of the rf energy. With no humps, no standing waves are created. The cure for unwanted standing waves, then, is to remove the humps.

The easiest way to do this in theory is to adjust the antenna impedance until it's a perfect match for the feedline. Then there will be no hump, and no problem. The swr will be 1.0.

However, antenna impedance is subject to many variables, and feedlines come in only a few impedance levels. What if they don't match?

The answer in this case is to introduce a "matching network," which is a fancy name for "anything that will make a smooth match." A tuned circuit makes an excellent matching network; when it's resonant, you can get almost any impedance levels you like by just tapping the coil at the proper number of turns. These are often used, and known as "antenna tuners," but usually a long run of mismatched feedline separates the antenna and the tuner, with a short run of line from transmitter to tuner. The swr is low only over this short line.

Many other types of matching networks are possible. Impedance of a parallel-conductor line depends upon its conductor spacing, in part, so a "tapered" section can be built which changes smoothly from one impedance level to another, and used as a transformer.

It's also possible to use a quarter-wave section of feedline and a transformer to step impedance up or down, and to cascade several such sections if necessary to get the proper ratio.

Any antenna handbook includes quite a bit of material on impedance matching networks, because they are the heart of practical antenna construction.

One point mentioned in FCC study question 43 has not yet been discussed, and it fits into a discussion of matching networks as well as it does anywhere else. That's the subject of protection against lightning.

Obviously, any large metallic structure such as an antenna is a tempting target for lightning, and since the laws of nature have

neither conscience nor memory, it's a fairly good bet that unless equipment is protected, it can be damaged.

The most certain protection is a large knife switch, of the sort you see in old monster movies where the mad scientist shoves home the switch to jolt life into his creation. A hefty switch of this nature, with the arms connected to the antenna, one pair of poles to the equipment, and the other pair directly to ground with a short, heavy braided strap, provides almost certain lightning protection. The energy need not jump the gap to get to the equipment, when it has a direct path to ground.

Such a switch upsets the swr on coax lines, though, and isn't the most attractive item in any station. An alternate but less sure means of protection is to disconnect the antenna cable from the equipment and connect it to a direct ground whenever a thunderstorm threatens, and whenever the station is not in use.

Lightning arrestors are sold which provide a spark gap and are said to help prevent lightning damage. While they work as claimed, they are much less sure protection than is physical disconnection of antenna leads.

. . . Staff■

A. D. Taylor GW8PG
37, Pickerill Road,
Greasby,
Upton,
Wirral,
Cheshire,
England

The Pink Ticket Rejector

Hams sometimes get into trouble with the FCC because they have made a mistake in tuning a frequency multiplier or PA stage. For example, if the multiplier stage following a 3.5 MHz oscillator is accidentally tuned to 10.5 MHz instead of 7 MHz, the PA can be loaded on 10.5 MHz; and if this is done even a short transmission is likely to produce an unwanted "QSL" from the FCC! Mistakes like this can be prevented by using the simple, easily built absorption wavemeter shown in Fig. 1. Only one coil is required in this meter, the low frequency range being obtained by switching a padding capacitor in parallel with the variable tuning capacitor. With switch S1 open the tuning range is approximately 6.8 to 30 MHz, and with S1 closed it is approximately 3.5 to 6.8 MHz.

Construction of the wavemeter is simple. It can be put together in a metal utility box, on a wooden panel and baseboard, or even in a cracker can of the right size. The coil can be wound on any type of ¾ in. diameter form. If nothing else is handy, a short length of dowel could be used. The coil winding consists of 7 turns of 20-gage

wire, close wound. Both the tuning capacitor (CI) and the padding capacitor (C2) should be 500 pF components, but the values of the other components are not critical.

Any meter having a full-scale deflection between 100 μA and 1 mA can be used. If the wavemeter is built in a metal box, L1 must be mounted outside the box. A slow-motion drive is not needed. If C1 is fitted with a pointer type knob and a cardboard scale is cemented onto the front panel, the calibration points can be written on the scale in ink.

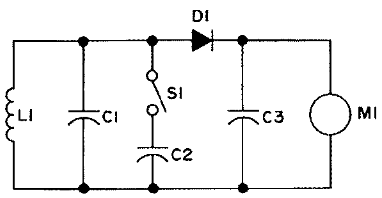

Fig. 1. L1 – 7 turns 20 gage enameled copper wire, close-wound on a ¾ in. form; C1 – 500 pF variable capacitor; C2 – 500 pF fixed capacitor; C3 – Fixed capacitor, any value between 1000 pF and 0.01 μF; D1 – Silicon or germanium; M1 – Moving coil-meter (100 mA–1 mA).

When it came to calibrating the wavemeter I thought of a simple method that I have not seen described before. I soldered about 2 in. of wire onto one end of L1, and about 10 ft of wire onto the other end. I then connected the short lead to the antenna terminal of my receiver and strung the 10 ft of wire up as a temporary antenna. I then tuned the receiver to a steady signal at each frequency at which I wanted a calibration point, and adjusted CI until the strength of the received signal suddenly dropped sharply, indicating that the wavemeter was tuned to the frequency of the signal. I was then able to mark this frequency on the cardboard tuning scale. The drop in signal strengh was very sharp so calibration was easy. Once enough calibration points had been obtained the temporary wires were unsoldered and the wavemeter was ready for use.

The only frequency which may require a little adjustment is 30 MHz. If the

wavemeter will not tune as high as this, push the top turn of coil LI about 1/8 in. away from the other turns. This should reduce the inductance sufficiently; a spot of cement will hold the turn in its new position.

To use the wavemeter for checking a transmitter, bring coil LI close to the tank coil of the stage being checked, apply power to the stage and rotate CI until a maximum reading is obtained on the meter. The output frequency of the stage can then be read off from the wavemeter tuning scale.

The wavemeter can also be used as a radiation meter for tuning up single-wire antennas. If it is tuned to the transmitter output frequency and placed near to the antenna wire, maximum reading on meter M1 will indicate maximum output power from the transmitter.

Many readers will have realized that the calibration method I suggest uses the principle of the rejector circuit. That is why I have called the little gadget "the pink ticket rejector"!

. . .GW8PG■

DX FROM THE STARS

Ron Fox WN4ONW
2311 Pressley Avenue
North Augusta SC 29841

It was late one Friday night in mid-October when I had completed my business in a small Georgia town about 70 miles west of Augusta. I am assistant manager for a finance company in Augusta and was headed home on Highway 88 after a particularly hard day. I was tired and sleepy, so I rolled my car window down and turned the radio up loud for fear of dozing at the wheel. I happened to be tuned to an Indiana clear-channel station when a special interview came on concerning a young couple in the midwest who claimed to have been taken aboard a UFO while traveling through Colorado high country.

As well as being a ham operator, I had been a general shortwave monitor for over fourteen years and I was particularly interested in UFO reports. The young couple's statement concerning strange sounding impulses on their car radio just before being abducted by the UFO was of special interest to me since I had been picking up strange impulses on my VHF monitor at home for the past two weeks. One night they appeared suddenly; weakly at first but gradually stronger, and only at night. I decided to experiment with a directional VHF antenna but my attempts to locate the signal were fruitless. It seemed to be of

equal intensity in all directions. Little did I suspect the signals to be coming from almost directly overhead, thousands of miles into space. I had never participated in moonbounce experiments but considered this as a possible source; but for what purpose?

Suddenly my train of thought was interrupted as an unusual amount of electrical interference started playing havoc with the car radio – unusual because I was on a desolate country road nowhere near any high-tension lines or buildings. Just an occasional farmhouse off the road in a field.

My curiosity aroused, I turned on my rig. All bands were dead except for pulsating zings remotely resembling the sound made by an Air Force radar station.

I was getting tired of playing guessing games and was becoming perturbed with the puzzling interference. Probably some clown with a linear amplifier on a wireless FM broadcaster, I thought. But then I noticed a faint halo of light on the road surrounding my car. This in itself might not have been unusual on a clear night like this except for the fact there was no moon out. The halo was keeping pace with my car at 60 mph. I speeded up, then slowed down; it stayed right with me. Suddenly a cold chill came over me. I knew it wasn't my imagination and I became aware of a strange noise above me like a jet airliner with engines at idle speed except it had a three-tone musical note.

I was too frightened to stop the car and I wanted to look out the window above me but the fear of what might be there kept my hands glued to the wheel, my back to the seat, and my eyes to the road for I was at least ten miles from civilization. I had never felt so alone before and I was beginning to wonder if maybe I really wasn't there at all but at home in my bed dreaming. I wanted desperately to believe that, but I knew this was for real as I started to recall the experiences of the young couple on the radio interview. I tried to console myself by remembering the fact that they were not harmed.

Just then a strange voice came from my ham radio. It was a hollow, metallic voice

such as you would imagine from a computer. If they were alien visitors, they must be trying to communicate, I thought. Through shortwave listening I had heard many languages from many countries but nothing had ever sounded like this. It was almost like a tape recording being played backwards. In desperation, I grabbed my microphone and shouted, "Who are you? What do you want? Where do you come from?" The only reply was more of the same mechanical "garble."

All I could think now was panicky half-thoughts. I was terrified at the thought of never reaching home again. Up ahead I saw the lights of a town. I slammed the accelerator to the floor and raced toward the approaching lights.

When I was about three miles from the town, the spacecraft veered off to my left enough so that I caught a terrifying glimpse of it. It was saucer shaped, about fifty feet in diameter with flaming red, blue, and green lights on its perimeter. It appeared to have a number of portholes encircling its dome and the bottom half was spinning at a fantastic rate of speed. The face I saw in the starboard porthole I could never describe because no one would believe me. I only knew that it was definitely alien.

As suddenly as it had appeared, the craft took a 90-degree left turn and hurled away upward toward the stars. The chill that engulfed me eased off and I slowed the car to a safe speed again. As the craft disappeared back into the heavens, the radio impulses faded away and my ham radio came to life again, teeming with activity on every band. With this, I nervously keyed my microphone, identified my mobile station and asked if any other hams in the area had seen anything unusual in the sky that evening. Several other locals answered my call and jokingly asked me to stop by for black coffee. It sounded to them as if I needed it.

This was the only QSO I never logged for I knew that I was the first and only earthbound radio amateur to have worked DX from beyond the stars, but who would believe me? Do you?

...WN4ONW■

73 Reader Service Coupon

Now we don't say that every single reader must buy every last product advertised in 73. We believe that, but we don't say it. The very least every reader can do is put on a show of interest in the products herein advertised. To make this a simple task, even for the laziest reader (now there is a contest for you!), we have cleverly arranged the advertising index to double as a reader's service coupon. All you have to do is tear it out (or photocopy it) and send it in with the appropriate boxes marked. (We have a prize for the most boxes marked . . . a silent prayer of thanks from the publisher). We'll accept postcards, slips of paper, or almost anything else that lists the companies you want to hear from and your address.

No one likes to go into a store without buying something, right? It is the same with these information requests. You will be expected to buy something. Oh, it doesn't have to be a $50,000 antenna system, but it should be something modest . . . a transceiver . . . a linear . . . you know. We'll leave the decision up to you, knowing that we can trust you to do the right thing.

And we are definitely not saying that the use of this service coupon has any curative powers, but we cannot but notice that many readers report remarkable relief from simple backache, headaches, lumbago, and acid indigestion after sending in their coupon. Why take any chances?

ADVERTISER INDEX *August, 1971*

Mail to: **73 INC., PETERBOROUGH NH 03458**

Name ______________________ Call __________

Address ________________________________

______________________ Zip __________

PROPAGATION CHART
J. H. Nelson

Good: Open/Fair: O/Poor: ☐

August 1971

SUN	MON	TUES	WED	THUR	FRI	SAT
1	2	3	4	5	6	$\boxed{7}$
8	9	$\boxed{10}$	11	12	13	14
15	16	17	18	19	20	21
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29	30	31				

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7A	7A	14	14
ARGENTINA	14	14	14	7A	7	7	14	14	14A	21	21	21
AUSTRALIA	14	14	7B	7B	7B	7	7	14B	7	7	14	14
CANAL ZONE	21	14	14	7	7	7	14	14	14	21	21	21
ENGLAND	7A	7	7	7	7	7A	14	14	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7	14	14	14	14
INDIA	7	7	7B	7B	7B	7B	14	14	14	14	14	7A
JAPAN	14	14	7	7	7B	7	7	14B	7	7	14	14
MEXICO	14A	14	7A	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	7B	7B	7B	7B	7B	14B	14	14	14	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	14	14	14	21	14	14	14
U. S. S. R.	7	7	7	7	7	7A	14	14	14	14	14	14
WEST COAST	14	14	7A	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

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ALASKA	14	14	14	7	7	7	7	7	7A	14	14	14
ARGENTINA	14	14	14	7A	7	7	14	14	14	21	21	21
AUSTRALIA	21	21	14	14	7A	7	7	14B	7	7	14	14A
CANAL ZONE	21	14	14	7A	7	7	14	14	14	21	21	21
ENGLAND	7A	7	7	7	7	7	7A	14	14	14	14	14
HAWAII	14A	14A	14	14	7A	7	7	7	14	14	14	14
INDIA	14	14	7B	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	7	7B	7	7	7	7	7	14	14
MEXICO	14	14	7	7	7	7	7	7	14	14	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
PUERTO RICO	14A	14	7A	7	7	7	7	14	14	14	14	14A
SOUTH AFRICA	7	7	7	7	7B	7B	14	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7	14	14	14	14	14

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7	7A	14	14	14
ARGENTINA	14	14	14	14	7A	7	7	14	14	14A	21	21
AUSTRALIA	21	21	21	14	14	14	14	7	7	7	14	21
CANAL ZONE	21	14	14	7A	7	7	7	14	14	14	21	21
ENGLAND	7	7	7	7	7	7	7	7	7A	14	14	14
HAWAII	21	21	21	14	14	14	7A	7	14	14	14	21
INDIA	14	14	14	7A	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	14	7A	7	7	7	7	7	14	14
MEXICO	14	14	14	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	7A	7B	7B	7B	14	14	14	14
PUERTO RICO	14A	14	14	7	7	7	7	14	14	14	14	14A
SOUTH AFRICA	7B	7E	7	7	7	7	7B	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7	7	14	14	14	14
EAST COAST	14	14	7A	7	7	7	7	14	14	14	14	14

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

AMATEUR RADIO 73

#132
September 1971
One Dollar

IC Substitution Guide

Tracking Down Man - Made Interference

Six Transformerless Power Supplies

CONSTRUCTION

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73 MAGAZINE

#132 SEPTEMBER 1971

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STAFF

73 Magazine is published monthly by 73 Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas. $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough, N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. *Phone: 603-924-3873. What good can possibly come of your buying products not advertised in 73? Why take chances? If they were any good at all, wouldn't they be advertised in 73?*

Cover: Posterized print of the VHF Contest effort by the Waltham Amateur Radio Club on Pack Monadnock in Peterborough, N.H. this last June. Credit Roger Block with the effect if you like it.

Amateur Radio News Page

SEPTEMBER MCMLXXI | Monthly Ham News of the World | 73 MAGAZINE

CINCY TOWER VICTORY

Hams can breathe a little bit easier after another favorable ruling in a tower case recently settled near Cincinnati. Carl Dettmar, W8NCV, of Finneytown, Ohio, applied to the Hamilton County Zoning Board for a building permit to erect a 64-foot tower in his back yard. Although starting out with the consent of his neighbors, his original request was refused. While appealing this decision some of his neighbors withdrew their consent and the board raised the question of TVI. Carl replied to the TVI inquiry that he could not guarantee that there would not be TVI, but he would work with anybody affected should the problem arise.

Carl's appeal was rejected unanimously by the board.

At this point Carl contacted Ben Turpen (W8CQM), a local attorney, and they agreed to take the matter to court. Realizing the importance to other amateurs around the country as well as hams in the immediate area, the Greater Cincinnati Amateur Radio Association agreed to pay the court costs.

In May of 1971, approximately one year after Carl's original permit application, Judge Gilbert Bettman of the Hamilton County Common Pleas Court ruled that because amateur towers are not specifically excluded by the area's zoning restrictions, and as long as ham radio is a legitimate family hobby, Carl could erect his tower. The judge continued, "We find nothing in the zoning resolution making Dettmar's proposed use unlawful. The fact that not many people have amateur radio antennae no more precludes their use than the fact that not many people have tennis courts precludes their use."

Hams around the country might all thank Carl, Ben, and the GCARA for their time, money, and perseverance.

WITH THE DX YACHT "REVERIE"

Leaving Annapolis, Md., the *Reverie* passed buoy 73 and hauled up the signal flag 73. Skipper Tex Zammit, K4MJZ, and yachtsman Steve Titus, were ten miles closer to the start of the 73 DXpedition.

Following the Annapolis departure on July 3rd, the *Reverie* stopped in Oxford, Maryland at the Phillip Morris Inn for what Tex maintains is the best bowl of She Crab Soup in the world. Ham yachtsmen may know Oxford as the beautiful little harbor town where the clock seems to have stopped over a century ago. It is a popular rendezvous for larger yachts.

After a cautious sail around the ship graveyard – Cape Hatteras – Tex and Steve proceeded to West Palm Beach, Florida, where they spent the rest of July stocking the *Reverie's* larder and making final repairs and adjustments.

Upon arriving in Florida, Tex got the first few of his Caribbean ham licenses in order. These include permission to operate in the Bahamas, British Virgin Islands, and the Caicos and Turks Islands.

Make sure you have sent in the DX coupon on page 55 of last month's 73

73 BIG GUNS

High officials at 73 Headquarters in the remote wilds of New Hampshire refused to deny the consistent rumor that the magazine will soon be published from a new floating headquarters ship. It is understood that the Coast Guard has expressed some concern over the recent exercises well off the New Hampshire shores by the 73 crew.

Wayne Green has flatly denied that he has any intention of anchoring the new 73 headquarters ship off the coast of Long Island within gun range of Port Washington or that any harm has been threatened to the CQ Luxury Yacht from which Cowan directs his publishing empire.

Green has evasively hinted at using the ship for DXpeditions to some of the rarer islands around the world, but inside word has it that Cowan has secretly been arming his yacht to the teeth and that the beleagered group at Ham Radio have been bidding on a used rowboat so as not to be left completely behind.

"WORLDRADIO"
HAMS HELPING HAMS

"After twelve years as a ham I think there has to be something more challenging than "S" meter reports and comparing tower heights, over and over and over again.' Perhaps we zations mentioned. Nobody on *Worldradio* receives a salary, except for a few clerical helpers. *Worldradio* is trying to be impartial and to avoid conflicts, yet its pages are open to all.

CLUB HELPS CHILDREN
VERBAL CRIPPLES COMMUNICATE

have all felt this way once in a while, but the man who spoke these words did something about it. Armond Noble (WB6AUH) started *Worldradio* to help people.

And many dedicated fellow amateurs have come forward to work with him on *Worldradio*.

Worldradio is a new newspaper based on the premise that ham radio can be a resource for good and increased understanding around the world. Armond, a professional journalist whose work has been featured in *Time* and other leading magazines, has gathered a group of other prominent hams and ham-journalists to put out a newspaper to feature the positive, the good, the life-saving, and the human aspects of our hobby. This all reflects Armond's view, "What a wonderful thing this communication. And how much more challenging and fulfilling when used for a real purpose."

Worldradio has a sterling list of purposes. Included in the activities which *Worldradio* is supporting with money and coverage are Airmen's Memorial School on New Britain Island (run by Fred WØFBG/VK9FH), Amigos de Las Americas – a youth oriented person to person program in Latin America, International Mission Radio Association, and the Minh-Quy Hospital in Kontum, Vietnam (a continuing program with Steve Olson W6EQM). Other groups include the S.S. Hope and Handi-Hams – a group of WØ-land hams who teach ham radio to blind and handicapped people. And there are more. *Worldradio* is also trying to build up a reserve of money to facilitate the purchase and shipment of needed medicines when a call comes in via ham radio for a needed medicine anywhere in the world. Yet another aim of the organization is to lend equipment to doctors, missionaries, and others who are traveling to areas where ham radio would be a vital tie to the outside world.

The spirit of helping other people via ham radio is, of course, a long tradition in our hobby. *Worldradio* though, is a new type of publication. Published every three weeks, it costs $5 a year in North America and $6 (46 IRCs) elsewhere. Ten percent of the budget is allocated to the organi-

Worldradio

THE INTERNATIONAL COMMUNICATIONS REPORT

They are trying to be positive, constructive, and cooperative – a tall order for any publication. One thing *Worldradio* is not, however, is technical. Armond feels the technical aspects of the hobby are interesting, but not as vital as the more human side of the hobby. And he feels that there is a need for a publication which can turn more people on to the work of teachers, doctors, missionaries, and travelers trying to make this a little better world.

For more information, a sample copy, or to subscribe, you can write to Armond Noble WB6AUH, 2509 Donner Way, Sacramento CA 95818.

There She Is...

The Southern Counties Amateur Radio Association is sponsoring a special events station in conjunction with the Miss America Pageant to be held in Atlantic City, New Jersey in September 1971. The station will operate from 5 September to 12 September. The call WX2MAP (Miss America Pageant) has been applied for. Planned operating frequencies are: CW – 3530, 7030, 14030, 21030 and 28030. SSB – 3915, 7265, 14290, 21365, 28515. Some operation in the Extra, Advanced, and Novice bands is likely.

QSL to Miss America Pageant, Atlantic City, New Jersey, or via K2JOX. Please enclose SASE.

with the DX you would like to see activated. Make certain your rig is working. It should be just a few short weeks before the *Reverie* will be on the air from the Caribbean. Until then, though, Tex is spending August, ". . . cruising around the Bahamas in whatever direction the tide and wind take me."

Scanning FM Transceiver

Regency has introduced Transcan (TM) base and mobile transceivers for the 2 Meter FM band.

The receiver section of the radio scans for an active signal on as many as 8 crystal controlled channels. At reception of a signal, the receiver automatically stops to listen to the entire transmission on a given frequency. At the end of the transmission, scanning is automatically resumed. Each frequency can be quickly programmed "in" or "out" of service by a push of the button.

All eight corresponding transmit channels are push button equipped too. When an individual button for the transmit channels is pushed, receiver scan process is automatically stopped and reception facility is locked on the channel paired to the transmitter.

The American manufactured sets boast .35 μV sensitivity for 20 dB quieting, modulation acceptance of ± 15 kHz, and 5 watts audio output with a built-in front panel speaker. Scanning rate is 15 channels per second. Front panel slide controls provide for adjustable volume and all electronic noise compensated squelch on the base unit while knobs are used on the mobile version. Both units, of course, are all solid-state.

Non-verbal children are able to make audible sounds, but are unable to coordinate these sounds into meaningful communications. This inability to communicate often compounds the problems of speech therapy by starting off any therapist-child relationship with the child feeling frustrated and sometimes hopeless at his inability to communicate with an adult.

A state hospital in Hamburg, Pennsylvania, developed a technique to overcome this problem by putting a microphone and speaker in a stuffed animal. A child could then talk to the plaything and get replies from the toy – without having to actually face a therapist.

Using this idea, various Western Electric Chapters of the Telephone Pioneers have made talking dolls with 2-way, low power, FM radios. The Oklahoma City Amateur Radio and Electronics Club, an affiliate of both the Western Electric Company and the Oklahoma City Works, worked with the local chapter of the Telephone Pioneers to produce a talking doll for use by the Dale Rogers School for Retarded Children. Along with helping children, the project has generated much favorable publicity for hams and experimenters in the Oklahoma City area.

Other amateur radio clubs might take a hint from this example and see what sort of an interesting and public

Power output of the transmitter for both models is 15 watts across the entire 144–148 MHz bandwidth. Phase modulation with automatic deviation limiting can be internally adjusted from 0–15 kHz.

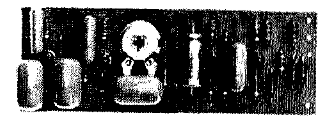
Model HR-2S 117V ac base measures 13" x 4" x 8½" and is priced at $349. Model HR-2MS 13.6V dc mobile measures 10" x 4" x 8½" and sells for $319. Prices include factory installed transmit and receive crystals for 146.94 MHz. *Regency Electronics, Inc., 7900 Pendleton Pike, Indianapolis IN 46226.*

Joe Hustak and Jim Hiatt with Jackie, 'The Talking Doll," a joint venture of the Western Electrical Council of Telephone Pioneers and OCARE.

service oriented project they can evolve.

(Adapted from a news feature in the OCARE BULLETIN, Oklahoma City Amateur Radio and Electronics Club, Summer issue.)

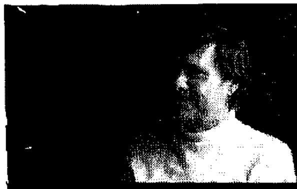
Sub-Audible Encoders and Decoders



Communications Specialists are now distributing a new sub-audible tone encoder and decoder designed for amateur FM applications. Compatible with all other sub-audible tone systems, these units come in kit form or already wired and tested. All units are powered directly by 12V dc. Any suitable reed can be used in the kits. All units come on glass epoxy PCBs, are small, stable, and can be used anywhere in the range from 67 Hz to 250 Hz. *Communications Specialists, P.O. Box 153, Brea CA 92621.*

Help the Ham Cause

Most public libraries would welcome donation of used but not obsolete amateur radio books – e.g. last year's Handbook after you get the new one.



NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

EXPO 71

Not wishing to miss anything as important as an Expo, especially after having enjoyed Expo 69 at Montreal and Expo 70 at San Antcnio, Lin and I hied off to Chicago with high hopes, to experience Expo 71 as presented by the Chicago FM Club.

Although the hamfest was perhaps just a bit less pretentious than the title, it was interesting and was enjoyed by hundreds of Chicagoland amateurs . . . mostly FM'ers. Belt-portables were everywhere and 146.94 MHz sounded more like a CB channel when the skip is on than a repeater channel.

Expo 71 exhibit area was large, open and uncrowded, making it easy for all to see the exhibits.

There were some mighty interesting exhibits, particularly for the FM operators. Regency unveiled their new units and had their order pads busy when the distributors got a look at the new FM scanner transceiver with eight scanned channels on receive and eight channels for transmitting. What a fantastic gadget this will be in those areas (like mine) where there are several repeaters and simplex channels to be

jinx that has shot down every special interest publication in amateur radio so far, including their predecessor, *FM Journal*. It is, I can vouch, extremely difficult to put out a ham magazine when it is of interest to everyone, and just about impossible when you cater to one special interest, such as repeater owners. Every owner should subscribe to the magazine – it's for you, so *support* it. If you don't support it, you won't have it long. It is expensive to put out a magazine, even when the type is set with a typewriter or it is mimeographed.

Lin meets the 73 readers at the 73 booth.

Mailing is expensive and getting more so. All you have to do is decide to wait a couple of months to see if they make it before gambling your money, and they won't make it. Be fair, subscribe.

The ham manufacturer exhibitors were helped out by several CB and commercial manufacturers such as Midland, React, RCA, Motorola, GE and Hewlett Packard, adding to the general interest of the hamfest. The

ductive possible course of action – and a reflection on the maturity (or lack of it) of the "mad-ee."

For instance, a few months ago when Ken got our little repeater set up on the nearby mountain top, he put it on 34/94 for a few days to test out its coverage. The reactions were interesting. Nearby W1ALE had been active on 34/94 and our WA1KGO repeater overlapped its coverage substantially. Did Ted get mad and raise hell? No, he cut back operation of his repeater to 12 minutes per hour on 34 and opened the 46 input for the rest of the time. This worked fine and there was little interference, even though the repeaters were only 35 miles apart.

Not so cooperative were some of the other chaps. Jamming with RTTY signals and other garbage were dumped into the 34 input around the clock. This was done by repeater operators, not just the users. For the most part the users were the innocent victims of the giant egos involved. Those of you with Freudian leanings may prefer to think of repeaters in that context – hi!

May I offer a suggestion? When the inevitable conflicts arise over repeaters, frequencies, coverage, simplex, and all that stuff that is so damned important that it is almost worth fighting to the death about, how about taking a very simple first step? Come up with a compromise that is equitable to all involved. The next step is to get the combatants together and talk about the compromise. A compromise might involve one group buying up the crystals of another. It might be that both groups could change their repeaters to different channels, leaving the disputed channel for simplex. A compromise cannot be one way. "You get off my channel" is no compromise. Sure, you were there first. Sure you have every right to the channel and the newcomers have no right. Give a little. Maybe you can hook your two repeaters together? Perhaps you can get

LEAKY LINES

by David Mann K2AGZ

If you saw the News Page in the June issue of 73, you are aware that the FCC is reported to be considering an inquiry into Sections 97.39 and 97.107, as well as Section 2 of Article 41, International Radio Regulations, in order to ascertain whether certain types of communications may continue to take place. This entire flap concerning operations such as the Eye Bank Net and Hurricane Watch, etc., focuses attention once again on the perfectly evident fact that there is unbelievable ambiguity and lack of precise meaning in the language of the rules which govern our activities as amateurs. For if the Federal Communications Commission has difficulty in determining the import and thrust of these regulations, how in the world can we individual hams be expected to understand them?

When it comes to situations of an emergency nature, there are no points of confusion or misunderstanding. We know that in those cases we are perfectly free to pitch in and lend a hand, rendering our services in order to facilitate and assist in whatever activity is being carried out . . . epidemic, fire, flood, earthquake or other catastrophe.

But the confusion arises concerning non-emergency participation, which may be prohibited by the regulations cited. If our work in those fields is to be curtailed or limited to some degree, the change may have an overall damaging effect upon the future of amateur radio, for it might pave the way for an eventual loss of amateur frequencies. This is a sorry prospect which demands the close scrutiny of every individual amateur and every radio club. It implies a threat to the continued existence of ham radio itself; and for that reason, as we have become more valuable than ever before, we ought to be doing all in our power to concentrate upon our public service participation, so as to insure against any encroachment upon our allotment of spectrum space.

But if a new interpretation forbids participation in such activities, we stand to be accused of using this valuable resource in a frivolous fashion, which might very easily lead to our losing it altogether. And make no mistake about it . . . there are forces waiting on the sidelines, ready, willing and eager to assume custody and proprietary title of our frequencies at a moment's notice!

If the FCC should determine that we may not render assistance to these types of operations under the present context of the regulations, then we ought to be propagandizing and publicizing the urgent necessity for revisions of the rules so that we may participate. But how do we accomplish this objective? How can we make it clear to the Commission that it is absolutely mandatory for the rules to be rewritten in a totally unambiguous fashion so there can be no doubt as to their spirit and intent?

Once again we come to the inevitable conclusion . . . that Amateur Radio is in desperate need of adequate public relations machinery which will guarantee security against the potential attacks upon us, from whatever quarter. Once again we must point to the perfectly obvious fact that without a broad program of public education and orientation, particularly in the Nation's Capital, wherein are located the nerve centers which can determine our future existence, we stand a perilous chance of being obliterated from the scene.

monitored. The new Standard FM hand unit with five channels should send a lot of engineers back to the labs and should help get hand transceivers into a lot more hands during the next year or so. Bully.

Probably the most popular booth was Spectronics where you could step up with your transceiver and check out the frequency on the counter and read the deviation. This is the outfit, I suspect, that is largely responsible for the large number of Motorola HT-220's that were all over the place.

The central exhibit area.

Sidebanders got all excited when they spied the new Japanese transceiver with 1 kHz nixie readout and 500 watts which Robyn (CB) has been importing. Watch for more on this one!

HAL Devices was showing their RTTY printer. We've been promised an article on this revolutionary development by George Perrine. It prints the TT message on a scope tube rather than paper. Damndest thing I ever saw. Watch out Teletype Corporation – watch out Kleinschmidt.

Dycomm displayed their widening line of FM gear – amplifiers, sniffer, repeater, frequency counter scaler, the works. They sure are busy for a new and relatively small company. The sniffer is great – just put it near a transistor and you find out if it is working. Also fine for tuning.

rpt magazine brought out their long awaited first issue and it was a nice effort. I am sure that we all wish them well and hope that they can break the

Crawford Electronics drew considerable interest with their little 2m FET preamplifier (as advertised in 73, by the way)

hamfest did well for its first year, and I think most of us are watching to see it greatly expanded in 1972.

FM Battles

My recent visit to the Chicago area for the hamfest made me all too aware of the depth of the conflicts that are growing over repeater channels, simplex operations, and other phases of FM which bring out the contentiousness in those inclined to be contentious.

One chap was absolutely furious with me for not immediately guaranteeing him that I would write a blistering editorial demanding that all those damned repeaters be taken off 94 – and taken off 94 right away! 94 is for simplex, dammit, and repeaters have no business on the frequency.

Now whether 94 should be for simplex or not is a moot point. I am sure that we can muster a goodly number of good, solid reasons why it should be and why it should not. I suspect that we can get together an even larger number of rationalizations for either side. But how many FM'ers are going to be convinced by all this bickering?

I am reminded of the old homily: "A man convinced against his will Is of the same opinion still."

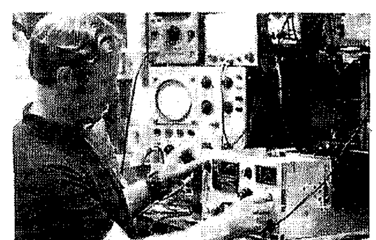
May I make an observation which will irritate all concerned? Getting mad about anything is the least productive... them to use tone access so both repeaters won't work at once? Work it out instead of making things miserable for everyone. Good grief!

73 Visits National Radio

National appears to have reorganized successfully after their bankruptcy last year and is swinging along with their NCX-1000 solid state transceiver. They've cut back on employees and management, keeping the older hard-core National people who helped make the name so famous.

While most of the ham gear is now being made at the new National factory in Maine, they are still making their well-known parts – and servicing – at the old plant in Melrose, just outside of Boston.

The new National 600 receiver is the apple of their eye, though it is obviously too expensive for the amateur. Apparently National has pulled quite a coup withthis new receiver, and is having more trouble keeping up with the orders than anything else. If you need a $3000 receiver, you might look it over.



Dan Morgan K1CSJ aligning an NCX-1000.

Although National receivers were far beyond my wildest dreams during the early days of my ham career, I did climb aboard as a happy National user in the late 40's with an RAO general coverage receiver from surplus and then invested in an old National 600 transmitter, a relic of the 30's. The power supplies and modulator are still in my shack today, now powering a kilowatt two-meter rig. Not bad, over 30 years later, eh? They certainly do build things to last.

Keep up the good work, National.

Washington Lobby

A note from WA4AEZ enclosed a clipping from *Astronautics and Aeronautics Magazine* for March, which mentioned that the AMA maintains its tax-free status while it has twelve full-time lobbyists in Washington. How about it, ARRL, if the AMA can do it, why not you? Maybe just one? We sure could use the help!

The AMA spends $1,500,000 a year on political action, which comes to about $7.50 per each of their 200,000 members. It seems to be well worth the money. Perhaps, if ARRL started offering us some lobby protection, they too would have 200,000 members.

PROSECUTORS WILL BE VIOLATED

This sign is available printed in solid black letters on yellow heavy card stock. 50¢ postpaid if the idea strikes you right. Send the half buck to *73 Magazine*, Peterborough NH 03458. Considering the cost of postage, big envelopes, and handling orders, we will not get rich on this.

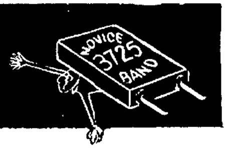
self, and is therefore a matter of the gravest importance.

Since the very being of amateur radio is predicated upon the fact that it is in the public interest, any interpretation holding that the very activities which promote the service aspects of the hobby are illegal can literally sound the death knell for all of us. If amateur radio is not able to point to its accomplishments in the fields of traffic, medical communications of a non-emergency nature, coordination of public events communications, participation in service nets, etc., then it might become very simple indeed for others to convince an International Allocations Conference that our amateur spectrum might well be reassigned to a "more essential" use. At a point in history when there is a shortage of frequencies and there are more potential assignees than spectrum space to satisfy the demand, it is particularly essential that ham radio should avoid being classified as a superfluous, hobby-type activity whose public service aspects are miniscule or negligible. In fact, it should be just the opposite. At a time like this, when our frequencies have be-

To draw an analogy; whether you are in favor of firearms or against them, you will have to acknowledge that the only force which has prevented wholesale imposition of anti-gun legislation has been the National Rifle Association, sometimes referred to as the "gun lobby." Every legislator, when discussing the reasons for the defeat of his particular anti-gun bill, has blamed it upon the NRA, which has maintained a strong public relations branch for this very purpose. Each time someone has offered such a bill, every senator and congressman has been deluged, inundated and drowned in a flood of letters, phone calls and wires from the constituency, alerted by the NRA, and these thousands of communications have left absolutely no doubt as to what would happen at the polls in the next election if he were foolhardy enough to vote in favor of the measure. Now, pro or con firearms, you must grant that this has proven to be an effective means of dealing with the situation. To all of which I ask, simply, "Is that bad?" Do we not regard our own activity, ham radio, with as much

(continued on News Page 6)

NOVICE



Does the DX Decade Club seem impossible with your 75 watts and 40 meter dipole? Are you as firmly convinced as I am that there are absolutely no Novices on the air from Vermont – or Wyoming – or Delaware? Does the thought of working all zones – including impossible zone 23 – strike you as a nice goal but too impossible to really slave over? Well, 73 Magazine is issuing a series of awards for real hams – not the storybook ham with the big beam KW.

Among 73's awards is the WAZP – Worked All Zones Promised – for swearing that you would like to work all 40 zones. There is also an award which you will not find in the shack of any of the real big guns in ham radio. This is the CHC – Certificate Haters Club. You have to swear that you have never received a ham operating award and that, if you should ever receive one in the future, you will hate it with an active and all-encompassing hatred.

More seriously there are three 73 awards which actually recognize operating achievements – of sorts. One is the Worked Almost All States (WAAS) Award for working any 49 states. Similarly, there is a real endurance award which is surprisingly popular – the *Real* Rag Chewers Certificate (*R*RCC) for a six hour long, continuous, two-way QSO. Over five hundred of these awards have already been issued. It is 73's contribution to airwave pollution.

The DX Decade Club (DXDC) was started as a spoof of fanatic DXers with big beams and lots of power. For them, working 10 countries might just be an afternoon's diversion. However, the award has come to be a real operating achievement for QRPers, Novices, apartment dwellers and

The certificates are quite impressive, and if we can find the stickers we have sticker endorsements for CW, 15 meters, and SSB. To apply for CHC or WAZP, just send a signed statement attesting to the appropriate conditions. For the *R*RCC send the calls of the stations involved, the operators' names, and the time and date (*both* in GMT) of the beginning and end of the QSO. For the DXDC and WAAS, you must send the appropriate QSLs. Package them carefully and please include return postage so we can return them to you by first class mail. All the awards cost a buck (of course) and you can apply to the Novice Editor, 73 Magazine, Peterborough, N.H. 03458.

Like many hams, I got into the hobby after an apprenticeship as an SWL. The thrill of hearing Radio Japan, BBC, and HCJB has palled, but when the ham band QRM – and particularly the Novice band QRM – gets too heavy, I still do some SWLing. Like radio itself, there are as many challenges in SWLing as you care to make. Maybe Radio Peking is further away than Radio Progresso in Honduras, but to catch Radio Progresso you have to dig pretty deeply into the noise on 4920 kHz. Honduras thus becomes a great catch and Peking remains garden variety SWLing. Similarly Trans World Radio in Bonaire, Netherlands Antilles is an easy catch for almost any SWL. But the clandestine Radio Euzkadi is more of a catch although probably broadcasting from the same general area. Its exact location is a dark secret. Broadcasting with 80 kW on 13.250 and 15.080 kHz, Radio Euzkadi is "The Voice of the Basque Underground." An excerpt from their QSL might give an indication why their programming might be more interesting than the ordinary propaganda broadcast:

"Basques were a free nation throughout history. Franco's uprising in 1936, assisted by Hitler and Mussolini, crushed the Basques depriving

(4750 to 5060 kHz) will probably prove to be the best all-round tropical DX band – and the easiest. There are plenty of South American stations, and quite a few Caribbean, Oceania, and African stations.

A tougher DX hunting ground is 90 meters (3200 to 3400 kHz) which feature really low power provincial broadcasting. For the most part if you log anything on 90 meters, you will really be hearing what the people actually living in the country are hearing. The news will often be radically different from the news carried by the international broadcasting station located in the same nation's capital. There are a few truly rare DX catches which can only be found on 90 meters – including Malawi and Bougainville.

Perhaps the most challenging of all is the 120 meter band 2300 to 2500 kHz. Anyone familiar with the challenge of chasing DX on the 160 meter ham band will recognize the difficulty of listening to Latin America on 120.

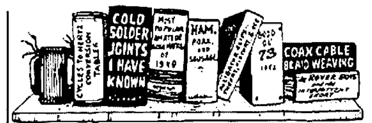
On all these tropical bands the keys to success are a good antenna and knowing when to listen. You have an idea when the bands will be in good shape by interpolating from the openings on the ham 40, 80, and 160 meter bands. Similarly, the tropical bands are almost useless during the day, but night owl and early morning DXers should have a heyday. Remember, all darkness transmission paths are necessary for any long haul reception. With the current downward spiral in the sunspot cycle and the end of summer, conditions are improving for tropical band DXing. Give it a chance the next time your DX-60 is down waiting for a new final.

. . .WA1KWJ■

HOT GEAR

should be on your gear somewhere. Then if you are contemplating buying a piece of used gear, it should be a simple matter to compare its number with our list.

So send your stolen equipment numbers to HOT GEAR 73 Magazine,



NEW BOOKS

Motorola has come out with a new edition of their *Semiconductor Cross-Reference Guide and Catalog*. Over 31,000 semiconductor devices are cross referenced to HEP replacements. The listing included 1N, 2N, 3N, JEDEC, and many special and Japanese type semiconductors. The catalog includes over 470 HEP products including kits, books, accessories, and the actual semiconductors. There are pages of base diagrams and min/max ratings and operating paramaters for the HEP products along with useful information on semiconductor experimenting and parts replacement in general. This really handy book is available free from your nearest HEP distributor. *MOTOROLA Semiconductors, Box 2953, Phoenix AZ 85036.*

New Literature

Cornell Electronics in San Diego puts out an interesting little catalog of miscellaneous devices including a wide selection of bargain 36¢ tubes, tools, gadgets, TV accessories, books, test meters, and audio parts. For the experimenter there are a few bargain component assortments of diodes, transistors and computer boards. The catalog has an interesting format with pages that you just tear out and send in as an order form. This makes ordering easier with less copying of catalog numbers and parts descriptions. A new catalog is sent, of course, upon receipt of an order. *Cornell Electronics Co., 4215 South University Avenue, San Diego CA 92105.*

GC Electronics Audiotex Catalog

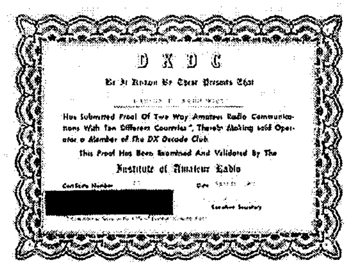
A new catalog containing all new entries in GC Electronics' greatly expanded Audiotex product line has been issued. The exhaustively illustrated 52-page, two-color catalog includes items for use in all phases of home electronics, hi-fi, TV, stereo, audio recording, intercoms, and experimentation.

Included in the booklet are a variety of antenna installation hardware items and an enlarged cable-connector-adaptor line for stereo equipment and other audio applications. The cable line includes connectors for virtually every piece of audio equipment made in the free world.

In all, the catalog (#FR-71-A) lists more than 350 items for the music listener and hobbyist including some 150 entirely new entries in the Audiotex line. *GC Electronics Div. of Hydrometals, Inc., 400 South Wyman St., Rockford IL 61101.*

New Indexing System by Switchcraft

Switchcraft has introduced a new indexing system in their 1971 Short Form Catalog. To index the collection of over 4000 switches, connectors, jacks, plugs, and cable assemblies, every page edge of the catalog has a vertical scale of numbers running to 125. Given any component serial number, one simply looks up the serial number in the index. Next to the serial number will be a page, column, and vertical placement number. One turns to the proper page, looks at the appropriate right or left hand column and finds the particular component listing next to the vertical scale number. While it sounds a bit complex, it all takes less than 10 seconds to find the detailed catalog listing of *any* component. One doesn't have to know the type of component, nor does one have to scan long lists of similar components searching for a particular specific serial number. The vertical scale puts you right next to whatever component you want. Perhaps if other manufacturers would follow this lead, the endless catalog searching accompanying the call or pilgrimage to the parts supplier might be minimized. *Switchcraft, Inc., 5555 North Elston Ave., Chicago IL 60630.*



A vintage DXDC certificate made out to Larson Rapp, WIOU.

others who can't just pull out all the stops and go DXing. Particularly for the Novice, it can take months of 15 meter operating to earn the DXDC – not to mention tracking down the QSLs. After the hunt, though, it is a valid recognition of an operating achievement.

them of the remnants of their ancient freedom. Now under Spanish rule, without elementary human rights, Basques fight under cover to restore democracy in their land."

After a few years of SWLing with a mediocre antenna, finally using my 137' ham dipole and antenna tuner made a world of difference. I could hear so much more – even on the regular 6, 9, 11 and 15 MHz international broadcast bands. Rare or not, I still enjoy the different music, the insight into the other countries, and the wholly different news broadcasts.

And there is one more aspect of SWLing which might entice the new amateur. Throughout the tropical regions of the world, domestic broadcasting is not done on our usual broadcast bands of 540 to 1600 kHz. Instead, the so-called "tropical bands" are used. The 60 meter tropical band

If your gear is stolen from your mobile or even from your home there is little that you can do except call the police, insurance company, and maybe get a mention in *Strays.* And while buying used equipment, there is little *you can do to make sure that the rig* you're buying wasn't stolen. We have been aware of this situation but is wasn't until we had a 2 meter FM rig stolen that we gave any serious thought to the situation. We intend to publish a list of stolen gear every month. If you rig is stolen we'll publish the model and serial number (or any distinguishing marks) for one whole year – free. We hope that this will help reputable used equipment dealers find stolen gear along with helping you in your private deals.

This service can't help you unless you write down the serial numbers of all your gear NOW – before it is stolen. Often your guarantee card will have this information, but if not, it

Peterborough NH 03458.

And for a starter, a Hallicrafters SR46A, six meter transceiver, serial no. 446100 was stolen from WA1EMU, L.E. Fitzroy, Box 219, Hinsdale MA 01235.

ELECTRONICS FAIR

Grice Electronics, Pensacola, Florida, is holding an electronics fair, Sept. 9–12. The first two days of the fair are directed to special industrial and government buyers and engineers. The last two days, however, are for the public, with manufacturers' displays and prizes. The event, celebrating Grice's 25th anniversary, is being promoted in all the media. Many new consumer oriented devices are expected to be exhibited. Amateurs in the area might write for more information to *Grice Electronics, 320 East Gregory St., Pensacola FL 32502.*

73 Schussers Challenge All

The crack 73 ski team, seen here on a training mission high in the New Hampshire Alps, is getting ready for a challenge from any other amateur radio team. Left to right are team leader Green, Jan of the Art Department, Lin, wife of the publisher, Taylor of the Traffic Department, Nancy (Art) and Phil Price of Circulation.

The team practices almost daily during ski season on the slopes of Onset, a local ski area, except during the week before publication when they all get down to business and stop schussing around. This is just one of the little benefits of working in a low rent district of the U.S.

OHIO

The Findlay RC will hold their annual hamfest on Sept. 12, 1971 at Riverside Park, Findlay, Ohio. Net meetings, flea market and commercial exhibits will be featured. Talk in on 146.94 MHz FM, 146.0 AM, 52.525 MHz FM, and 50.15 USB. For more information send an SASE to Box 587, Findlay OH 45840.

Old Time Hamfest

Old Time Hamfest, Indian Hills Radio Club, Sunday, Oct. 17, 1971, Slovenian Social Home, 20713 Recher Ave., Cleveland OH. Swap-and-shop, contests, dinner and prizes. This is an old fashioned hamfest, not a buy and sell affair, although there will be a swap shop and some commercial displays. Come for fun and education. For tuckets and further information write Gladys Zimmerman, WA8ZUK, Public Relations, Indian Hills Radio Club, 1504 Maple Grove Road, Cleveland OH 44121.

F.A.R. Hamfest

The Foundation for Amateur Radio, Inc., an organization consisting of 27 amateur radio clubs all located in the greater Washington, D.C. metropolitan area, will hold its annual hamfest on Sunday, 24 Oct. 1971 from 10 AM until 5 PM at the Gaithersburg Fairgrounds in nearby Gaithersburg MD just off Interstate 75. For more information, write M. F. Cone, WA4PBG, 317 Van Buren St., Falls Church VA 22046.

ILLINOIS

The Peoria Area ARC will hold its 14th annual Hamfest Sunday, Sept. 19, 1971, at Exposition Gardens (same place as last year), located on the northwest edge of Peoria IL. Lunch will be available. There will be plenty of activities for the entire family, beginning with the campsite opening the preceding evening. Free coffee and donuts from 9:00 to 9:30 AM CDT. Free swap section, parking, contests, and cartoons for the kids. Advance registration $1.50, at the gate $2.00. For further details and advance registration write Wendell McWilliams, WN9DZJ, Box 1, Rome IL 61562.

Fifth District QSO Party

The first annual QSO Party sponsored by 5th District Chapter 26, CHC, will feature certificates to high scorer in each state, province or country, and a trophy to highest score in the contest and to highest score in the 5th District. The same station may be worked on each band and mode, and mobiles may be worked again in different counties.

Contest runs from 0000 GMT, Sat., Oct. 9, 1971 until 0000 GMT, Mon., Oct. 11, 1971.

Exchange usual RST and QSO number plus state, county and country. Suggested frequencies are 3575, 3940, 7060, 7150, 7260, 14075, 14343, 21090, 21100, 21360, 28600, ssb 50.1–50.2, am 50.2–50.5, 145–147. Mail scores by Nov. 1 to Pat Pattee, W5POH, Mountain Home Ark. 72653.

Illinois QSO Party

The Radio Amateur Megacycle Society, K9CJU, will be sponsoring the ninth annual Illinois QSO Party from 1600 GMT, Nov. 6, 1971 until 2200 GMT, Nov. 7, 1971. All bands and all modes are to be used. Basically, out-of-state hams work Illinois counties. For details, awards, and suggested frequencies, send a SASE to K9CJU, 3620 N. Oleander Ave., Chicago IL 60634.

TELCO CONTEST

This year the Indian Hill ARC at Bell Labs Indian Hill facility, Naperville IL, will host the 12th annual "CQ-Western Electric" contest for all licensed amateur radio operators employed by or retired from Bell Laboratories, Western Electric, AT&T, and Teletype and Sandia Corporations. The objective of this world-wide contest is for each participant to contact as many other participants as possible via ham radio.

The contest will be held on the first three weekends in October with each weekend devoted to a different mode of amateur radio operation. The first weekend will be CW (with special Novice competition), the second weekend, phone, and the final weekend will have a period for RTTY and VHF operation.

Awards to to the individual with the highest contest score and top scores in various categories of operation, and to the retiree with the highest score. There is also a traveling trophy which is sent to the company location with the highest score.

The contest rules have been formulated to encourage the participation of retirees. There will be bonus points for retiree contacts.

Anyone can obtain a complete set of the contest rules by contacting the amateur radio club at his base location or Indian Hill Amateur Radio Club, Bell Telephone Laboratories, Naperville IL 60540.

DX FOOTNOTES

While both Chinas have been in the news recently, there has also been some noteworthy DX activity from both Red China and Taiwan. While nobody is positive whether BY1AB and BY1AA are genuine, beam headings from both Japan and the West Coast indicate that the stations do seem to be in Red China. BV2A continues to appear on 20 CW and a group of Japanese hams are plowing through the red tape aiming at a BV expedition for a future DX contest.

A few more weird prefixes for those who have been following this column: WL2NAS, at the 50th anniversary Lighter-Than-Air Celebration in Lakehurst, N.J., KC2GMF, Greater Monmouth County Fair: KF4SJ, commemorating the 450th anniversary of San Juan, Puerto Rico (QSL to Box 1871, Ponce, Puerto Rico 00721); and WSØATA, Bellevue,, Nebraska RC. From Japan we're hearing the JE1 and the JR1 prefixes. And just a few years ago you thought that WB2 sounded funny.

Peruvian stations can use a special OB prefix for the remainder of this year. There is a special award for working 15 OBs.

While 73 is running our survey to find out the most wanted Caribbean DX for the *Reverie* DXpedition, the DARC polled German DXers for their worldwide most wanted list. The rarest countries are Clipperton (the rarest of them all), Minerva Reef, Bouvet, British Phoenix, Maria Theresa, China, Willis, Tonga, Tokelaus, and Revilla Gigedo. Plan your DXpeditions accordingly!

C21AA has been found operating on 14185 kHz and listening on 14200 kHz. This is just an example of why a good search through the entire band time can receive a helping hand in working Tom. This is, of course, a lot easier way to work VR6TC than battling the hoards calling Tom after the schedule. A SASE is a necessity in getting a Pitcairn card, and contributions are sought to keep VR6TC's gear in operating condition.

Another helping hand for would be big guns – the Micronesia Net often attracts some good DX. Although basically a traffic net, courteous operating should result in a boost in your countries total. The net meets Tuesdays, Thursdays, and Saturdays at 0800 GMT on 14335 kHz.

From the DX Footnotes mailbag . . .

I suggest you scan the letters column for the letters concerning operation from Turkey. It seems that with the declaration of martial law in that country, ham operation was ended although it had previously been tacitly permitted but officially prohibited. Ham gear has been confiscated, hams have been jailed and fined, and many hams have gone underground. It's not a good time to be a TA.

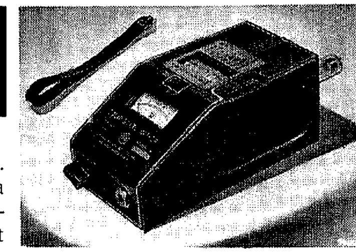
Tom Karlsson, SM1CNS and SM6CNS/MM, has asked for others' opinions on moving W1AW's code practice out of the low ends of 40 and 20. Tom maintains that the code practice frequencies interfere with foreign DXers and suggests that a change of W1AW frequencies to 7050 and 14080 kHz would be most helpful. Tom has already written to the League about the problems of foreign DXers . . . but without a reply. As one can see from the picture, Tom has quite a neat little shack.

NEW PRODUCTS

Mobile Battery Aid

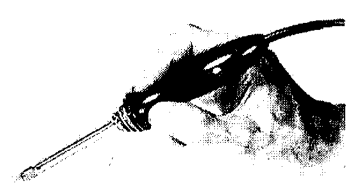
The Terado Corp. of St. Paul, Minn. has announced the production of a new R-V-CHARG unit. The R-V-CHARG model #50-125 is a compact solid-state controlled unit which allows the amateur radio operator to operate his mobile equipment from a separate battery while parked with the automobile. It automatically disconnects the main starting battery in the vehicle when the engine is off. This R-V-CHARG equipment has the advantage of keeping both batteries charged while the vehicle is running.

R-V-CHARG is installed under the hood of the car without any holes through the firewall. It takes a few simple connections to the electrical system and is ready to handle 150 A. The unit is solid state controlled and compact. It lists for $13.95. *Terado Corp., 1068 Raymond Avenue, St. Paul MN 55108.*



Controlled Temp Soldering Iron

Telvac Instrument Co. has introduced a soldering iron with controllable temperature from 400° to 750° F. Called the Oryx Model 50, this iron has a built in thermostat to keep the iron's temperature constant at the desired heat. The 50 watt element features fast initial heating and near instantaneous recovery from heavy joint loads (e.g. lugs and heavy termin-



Solid-State Dipper

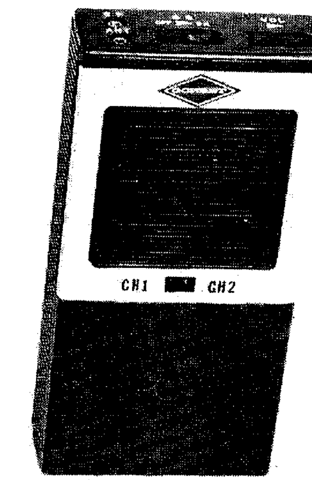
The Millen Co. has announced a new solid-state dipper to replace their familiar tube grid dipmeter. Powered by a 9 volt battery, the new dipper (number 90652) is said to equal the performance of the tube grid dipper but to include all the advantage of portability and a built in power source. Covering the range from 1.7 to 300 MHz with 7 plug-in coils, the dipper can be used to monitor modulation, check resonant frequencies of non-energized resonant circuits, and can be changed by simply plugging in a TN-91 of the frequency desired. Each Silent tone contains two sections, the encoder network (ST-85H), and the tone determining network (TN-91H), and features small size, 1-1/8" x 1-1/4" x 5/8", built in voltage regulation and one year 100% warranty. *Alpha Electronic Services, Inc., 8431 Monroe Ave., Stanton CA 90680.*

Do It Yourself Custom Resistors

Digital Instruments Corp. introduced their new resistance kit called FLEXTRIM. This wire kit is intended for use in making any value resistor, shunt or multiplier in connection with repair, production and experimental electronic work immediately. Both Manganin and Karma wire are used because of their low temperature coefficient of resistance and neither changes their value with age or temperature which is encountered in normal use. Resistors cost approximately .02¢ each.

tivate the receiver. The Silent tone encoder (ST-85I) can be used where the repeater only is to be quieted. The new transistorized circuitry and the elimination of mechanical reeds and relays makes this thoroughly field tested unit stable and reliable.

Tone frequencies are available in a wide choice (20.0 to 203.5 Hz) and act as an absorption type wavemeter. This straightforward and rugged meter sells for $110. *James Millen Mfg. Co., Malden MA 02148.*



Gonset VHF Portable Receiver

GONSET announced its new model 6 RP VHF high-band, personal portable receiver. The GONSET model 6RP is a high-performance, FM narrow-band "pocket" type receiver, with built-in antenna for monitoring over the range of 146 to 160 MHz. The 6RP may be powered with replaceable mercury cells, or rechargeable nickel cadmium battieres. Other options include two-frequency capability. The 6RP also features signal-to-noise ratio squelch, which is adjustable from the outside of the unit. *Aerotron, Inc., P.O. Box 6527, Raleigh NC 27608.*

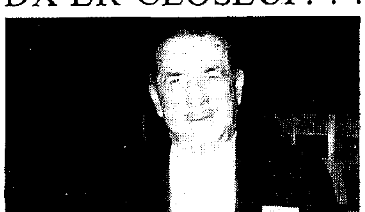
can often produce more DX than a cursory listen from 14200 up and then a CQ DX.

For those who no longer think of I, UA, G, or DL as DX, just try to snag 17ZCZ. He's been working into the U.S. using only 2 watts. Also running QRP is UA2CR. He's aboard an ice-breaker in the Barents Sea and he runs 3 watts of SSB.

There still is a lot of DX to be snagged through the DX nets. Some of the rarest Middle Eastern DX stations form the Middle East DXing Society which is offering the Arabian Knights certificate for working 10 Arab countries (must include JY1) after January 1, 1971. Seven IRCs and a verified QSO list to JY1 are required for the award. To work the 10, try getting on a list formed on Thursdays at 1900 GMT on 14295 MHz. The DX should then appear on Saturdays at 1800 GMT on 14295 kHz.

I don't know if it is having read *Mutiny on the Bounty* too many times as a kid or whether it was umpteen *National Geographic* articles on Pitcairn Island, but somehow working Tom Christian, VR6TC, on Pitcairn Island seems like extraordinarily enticing DX. Luckily, lower power stations stand a chance to work Tom by contacting his QSL manager, W5OLG (Bob), *BEFORE* 2045 GMT Tuesdays on 21352 kHz. This is the time for Bob's weekly sked with Tom. Those who hook Bob before schedule

DX'ER CLOSEUP. . .



WA2RAU, Doc, who engineered the shipment of tons of medicines to the Congo and who can be heard almost daily just about anywhere in the world on 20 meters.

K7GHZ wrote to say that his friend EP2DM (Jauad) will be on the air from Iran until October before his return to teach at Florida State University. QSL via K7GHZ, 3213 "R" St., Vancouver, Wash. 98663.

The following is exerpted from a South African Radio League notice:

A DXpedition will be held during the 9th and 10th of October, 1971, when Jack ZS3KC and Smitty ZS3XQ will take a trip to the well known Cape Cross, where Diego Cao planted his cross in 1482 after his long sea journey to establish the South point of Africa. The call ZS3CCE will be used for this expedition. The time of operating will be from 2200 GMT 8th till 2200 GMT 10th October, 1971, non stop. CW and SSB to be used on the following frequenies:

SSB: 7.070, 14.200, 21.280, and 28.600 MHz.

CW: 7.020, 14.050, 21.050, and 28.050 MHz.

In case of occupation of the mentioned frequencies, transmission will take place within ten kHz on either side. It would be appreciated if the above mentioned frequencies could be kept unoccupied during that weekend.

QSL cards will be sent out via the bureau for every successful contact. The duration of all contacts should be limited. (No rag chewing).

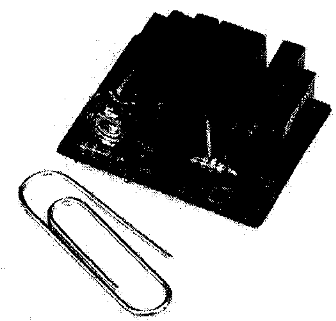
The Virgin Islands Transmitting and Listening Society (VITALS) wrote in to announce a mini-DXpedition during the period October 9–17. Along with maritime mobile operation, the operators hope to work from PJ8, FS7, and VP2. Look for them on 20, 15, and 10 meter CW and SSB. QSL with a SASE via air mail to Command Communications, Box 3374, St. Thomas, Virgin Islands

So, please let me know if this different type of DX column is helping any of you snag a few more countries. I hope it will be more interesting and more helpful than a long list of who worked whom. Don't forget the free subscription to 73 for each usable DX photo. WA1KWJ■

als). A wide variety of tip shapes, sizes, and materials are offered along with an optional safety stand and two or three wire line cord. *Tetvac Instrument Co., 14614 Raymer St., Van Nuys CA 91405.*

Miniature IC Sub-Audible Tone

Offered as the first all integrated circuit sub-audible tone encoder/decoder, Alpha Electronic Services Inc. announced its new SS-80J. Measuring less than one square inch including the new TN-91J frequency determining IC module, the SS-80J is the smallest non-reed CTCSS device available.



The unit was designed especially to offer high reliability by the elimination of mechanical and contactless reeds and still be small enough to be installed in hand-held transceivers and pocket pager receivers.

Under development for two years, the SS-80J has been subjected to a rigorous testing program to establish long-term reliability. Claiming excellent stability, the unit meets or exceeds all applicable EIA specifications and is available in standard or special frequencies from 20 Hz to 250 Hz.

Special configurations are available for easy mounting in most hand-held and portable units along with instruction manuals that clearly outline step-by-step installation. *Alpha Electronic Services Inc., 8431 Monroe Ave., Stanton CA 90680.*

Kit 101 contains fine wire alloys whose availability prior to this was only in bulk and at a price not economical for the average experimenter, technician, engineer, amateur, etc.

Kit 101 contains 7 resistance wires ranging from 0.5–300Ω per foot (5000Ω per foot optional), 11 epoxy glass bobbins, instructions, simple schematics, all neatly arranged and identified. The complete kit is housed in an acrylic plastic container.

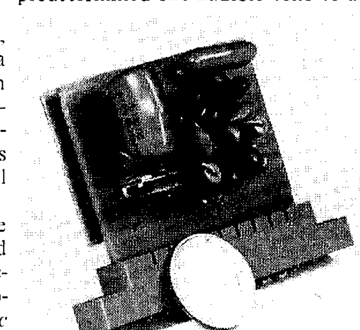
The wires used boast of low noise, high thermal stability, polyurethane enamel insulation, average tensile strength of 180,000 PSI, and being non-magnetic.

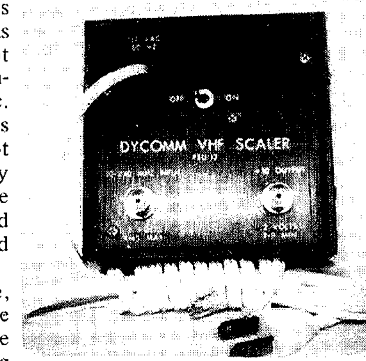
Typical applications include instrument calibration and repair, Wheatstone bridge construction, audio and hi-fi circuits, and modification of current and volt meters.

The kit costs $12.95 from *Digital Instruments, Inc., 19025 Parthenia / Northridge CA 91324.*

Continuous Tone Encoder

Alpha has announced a miniature all solid state continuous Silent tone encoder designed for use in all two-way radio communications systems and equipment. They say it is compact, easily installed, and provides an end to interfering signals and the necessity of listening to co-channel users by requiring that transmissions to repeaters be accompanied by a predetermined sub-audible tone to ac-





Low Cost VHF Pre-Scaler

Dynamic Communications has introduced a new divide-by-ten frequency pre-scaler/divider designed the PSU-13. It operates over a frequency range of 10 MHz to greater than 240 MHz. Circuitry features high input sensitivity (less than 100 mV) and high output voltage (greater than 2V p-p). The unit can be used to expand the frequency range of counters and oscilloscope synchronization. Proper operation is automatic, and the price is an incredible $89.95. *Dynamic Communications, P.O. Box 10116, Riviera Beach FL 33404.*

UHF Amplifiers

TRW Semiconductor Division has introduced a series of microelectronics, broadband, UHF amplifiers to work in wide segments of the 403 to 512 MHz range. Different units in this series of tiny amplifiers have power outputs of .75 to 7.5W, power gains of 16 to 20 dB, and power inputs between 2 and 50 mW. All units boast efficiencies above 40%, wide temperature range, and standard 50Ω input and output impedances. The largest of the units – with 7.5 watts out on 5.2 MHz – has a volume of .6 cubic inch. The smallest is only about .33 cubic inch. *TRW Semiconductor Div., 14520 Aviation Blvd., Lawndale CA 90260.*

(Continued on News Page 5)

LETTERS

MARS

I'm an X-ray Technician in the U.S. Army stationed at the 97th General Hospital in Frankfurt, Germany. I enjoy reading your magazine very much.

As soon as I get my license, I plan to use my equipment to transmit calls from members of the Armed Forces here in Europe to relatives back in the States in an attempt to relieve a part of the load that's on the MARS system here. There are only 3 stations in Frankfurt to serve some 50,000 servicemen and women. One more station will certainly help. The typical MARS station operates 24 hours a day, 7 days a week.

The ham operators in the States are doing an *outstanding* job completing the calls. The people here who have used these services hold a high regard and admiration for the ham operator.

I think an in-depth article on MARS radio and the ham would be interesting and informative to the public, as well as helping the amateur image. It might even sell a few more magazines, too!

Our thanks go to the amateur operators of the U.S.

Box 44
97B Gen. Hosp.
APO N.Y. 09751

And our thanks to you! We are sorry that our letter-opening machine chopped off your signature so that we are unable to include it.

You mentioned you would like to know our views on amateur radio and the value of MARS. Well, amateur radio is one of the greatest hobbies I have run across yet. As soon as I get home my wife and I are seriously considering trying to get our own rig. Running MARS is by far the best and all that stuff . . . only on a sailboat (60 feet). It will start from Italy and come to Turkey via Greece, and come to the Aegean coast of Turkey and stop at the main tourist spots, such as Ephesus and Troy and Pergamum, all of which are in almost the same state as Pompeii. We would continue to Istanbul and spend 2-3 days and return to Italy, stopping at Izmir (ancient Smyrna) only. There would be no charges other than the $20 per day per person, including food and whatever else is required to live on a ship for 15 to 18 days. Land transport and tourist guide service also included. I would like to get opinions on this matter as to its feasibility where Americans are concerned. I plan to have the rig HW 100, and an extra receiver and transmitter and Teletype equipment on board. I thought it might be a little something extra for a person to be able to operate from the Mediterranean and Aegean. My purpose is to make money and enjoy a pleasant job at the same time, but I am also a history nut and I would like to acquaint people with the tremendous amount of historical riches in the country here. Most of it is on the coast, so a boat is a natural way to get there.

James Binder
SITE 137
APO N.Y. 09254

. . . and Answer

In a letter from one of the Turkish hams, the following data comes to light:

The following hams in Turkey have been arrested and have been put in Turkish prisons: TA1NC, TA1OR, TA3WW, TA3AY, TA3OZ, TA6VY . . . and others unknown to the Istanbul ARC.

(somewhere) the index you published for 1960 66, but it *is* kind of a pain in the neck to have to locate an article published in the last 4 years. Do you have any plans to publish an updated index?

Scott Marovich
530 West Barry St., Apt. 3C
Chicago IL 60657

After taking a good look at what has happened to the parcel post rates we upped the price of those binders to $5 so you made a smart move. It sure would be nice to have a good, thorough eleven year index, wouldn't it? If I have a few days with nothing whatever to do I may sit down and work one up. Say, perhaps a reader who has a complete collection of 73 would be interested in a project like that? Fame and fortune (ha!) await. . . . Wayne

BACK ISSUES

I am now almost 71 years of age and not in the best of health. I have a complete file of 73 all in as-new condition. Would like to sell, or would consider 144 MHz FM gear. Interested?

Cliff McCullough (W4HSV)
326 Malaluka Road
North Port Charlotte FL 33595

Anybody interested?

15 Meters

I wish to pose the following question. Why is 15 meters so dead at night? Naturally I am not talking about DX but I am talking about local ground wave contacts. This band would give many a Novice a real surprise and pleasure if they would make a concerted effort to use the nighttime potential of 15 meters for a local chitchat band. Forty is so loused up at night, but 15 is a lonely wasteland just begging to be discovered. A goodly part of ham radio is meeting people where you find them, and it is no mortal sin to QSO a guy ten or twenty miles up the road on 15 without the QRM of nighttime forty.

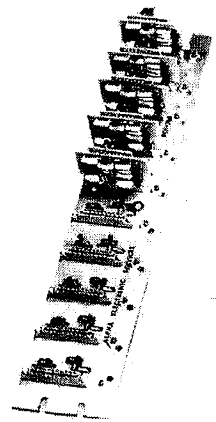
Allan S. Joffe W3KBM
531 East Durham St.
Philadelphia PA 19119

Perhaps everyone is now down on 2m FM?

(Continued from News Page 4)

Plug-in Repeater Tone Panel

Alpha Electronics has introduced a ten tone repeater control panel. Normally taking up to ten plug-in modules in the range of 20 to 203.5 Hz, the panel can be expanded to take up to forty different tones with an ac-



cessory panel. The board uses no reeds or relays for increased reliability. Normally powered by 12.6V dc, an optional 117V ac supply is available. The panel has built-in voltage regulation. *Alpha Electronics Services, 8431 Monroe Ave., Stanton CA 90680.*

OMISSIONS IN JULY

In the "New Literature" section of July's News Pages, we inadvertently left out the addresses of Signetics and GC. For Signetics' "Applications Memos," write to *SIGNETICS, 811 East Arques Avenue, Sunnyvale CA 94086*; for GC's General Catalog, address *GC ELECTRONICS, Div. of Hydrometals, Inc., 400 South Wyman Street, Rockford IL 61101.*

Good Project

In the May 73 Magazine, page 58, the article "Advanced Preamp-Compressor Clipper" appears like a very good project to build. Since the author has made quite a study of the subject I think it worthwhile to follow his efforts closely. Rather than guess,

REPEATER UPDATE

The Dalles, Oregon repeater was listed incorrectly. Located on Lookout Mt., it operates on 52.92/53.46. The call is W7FIO. A two meter repeater is being constructed by the same group, The Dalles ARC. It will operate on 146.34/146.94.

There is a new RACES related repeater in Valhalla, N.Y. Running 220W output at 750', K2AVP operates narrowband on 146.46/147.06. During the weekly RACES drill the alternative input frequency of 145.68 is used. It is an open repeater and covers southeastern N.Y., southwestern Conn., and northern N.J.

W9BYZ/9 in northern Illinois has added an additional input frequency to its listed 146.34/146.76. The repeater now operates on 146.16/146.76 also. A 1650 Hz tone burst is used.

An experimental ten meter FM repeater is operating in Ft. Walton Beach, Florida under the call WB4EQU. It uses a half second 1800 Hz tone for activation and normally works on 29.44/29.60. When simplex activity on 29.60 demands it, the output can be changed to 29.64. The machine is tape logged and users are asked to begin their first transmission with the time in GMT. The repeater is an experiment to test the feasbility of ten meter FM repeaters.

The repeater in Muncie, Indiana is K9SJI on 146.34/146.76. It is whistle on (1700 Hz) or can be activated with Touchtone 18. It has a coverage of about a 25 mile radius.

The Dayton, Ohio repeater, WB8CQK, operates without a tone on

job I have held in the Service. It really does something good inside of the OPS and for the people who use the system. Most of our thanks go to the hams and MARS stations in the States who give up their time to come up on the air and run patches for us.

Dick, Joel, Don & Gary
ARMY MARS STATION (AB9USA)
Korat, Thailand
AUG A, 442D SIG BN (LL)
APO S.F. 96233

Turkish Hams = Question

I am writing to ask about something in the March 1971 issue concerning a forbidden list of countries by ITU order. My call is WB2YFO and I applied to TRAC (Turkish Amateur Radio Club) for permission to operate when I got here, and they gave me TA6JB. I also have the membership booklet and ID card and all that. Operation is not strictly legal I think, since the law technically has never been changed to allow it, but I assumed there was some sort of unwritten agreement to allow operation if one joined the club, or so I was told. Now I see in the list I mentioned that TA calls are evidently considered outlaws, so I ceased operation so as not to get anyone in trouble that might contact me (about 300 every month until now), and I decided to write and find out the true story from you. I know the law is to be changed according to the government announcements. Everyone, including the government, knows of the club and the amateurs, since they were in the paper – pictures and all – and I can't understand how such a wide open operation can be completely illegal. They also print a monthly magazine which is sold on the newsstands in plain view. That is how I found out about it.

I am planning to have a sailboat that can carry 10 persons and crew for charter. I was planning to have my rig on there, either with my stateside license if possible, or another country like England or Italy, if I get a residence permit there. I would like to attract amateurs who would like to go for a cruise which will actually be like a bus or airline tour with guide, food,

In July, 1970, Selim, TA2SC, was arrested and his equipment confiscated. He was given a suspended sentence as he was a minor.

All this was brought about by the recent declaration of martial law in Turkey during the leftist terrorist acts.

The only way to bring about legalized amateur radio in Turkey is for the repeal of Turkish Law 3222, which forbids it.

Communications in Turkey come under the authority of The Ministery of Interior, Ankara, Turkey.

I'm not sure what can be done about their plight; however, ham radio there will be as rare as in Syria and Iraq if nothing is done.

Roland L. Guard Jr. K4EPI
750 Lily Flagg Road
Huntsville AL 35802

DISCREPANCY

There seems to be a conflicting statement of time required to assemble the Heathkit's new frequency counter – here is how I read it: Page 19 of June '73 shows the New 15 MHz Frequency Counter by Heathkit. In the list of specifics, the statement is made, "Easy five hour Assembly." Now let's look at the page 48 story, "I built a counter" where it states, "the kit had taken about 15 hours to complete . . . " What speed genius belonging to Heathkit's organization builds this kit in an easy five hours, assuming Sessions' story is accurate?

W. E. Nichols W6VVF
543-46th Avenue
San Francisco CA 94121

IN A BIND

Well, I've finally gone and done it . . . with an eleven-year collection of 73's sitting around, getting more dog-eared by the day, I figured there was just no other way. Please send me (ulp!) eleven 73 binders, with year-stickers for 1961–71, at a total cost of (gasp!) $44.00. Really, this hurts me more than it hurts you! The pain is killing me . . . I doubt if even a lifetime subscription could make it subside.

You know, once I get my collection bound, it certainly would be nice to have a new cumulative index to 73 articles through 1970. I do have

Thanks

Regarding an article in the April 1971 issue of 73 entitled "Stability without crystals," the article is incorrect in stating the MODCOM has no crystal. The MODCOM is a temperature compensated crystal oscillator and Sentry has always represented it accordingly.

We are naturally pleased at the test results conducted on the MODCOM and we sincerely appreciate 73's article since it accurately demonstrates the operational features and performance of the unit.

Michael W. Sigmon
Marketing Manager
SENTRY Manufacturing Co.
Chickasha OK 73018

FM . . .

This 2m FM is obviously an exciting mode. I certainly enjoyed the transceiver and repeater directory. I would sure have one of those new transceivers if there were any other hams in the area with similar equipment. Ken Sessions' article on FM was enlightening but how far will these typical transceivers reach out without a repeater? I fear if I had such a rig there would be no one in range to chat with. I think my subscription is almost up and would like a crack at one of those $50 life memberships you used to have on special. I've been looking but haven't seen it offered lately. Tell the advertisers to keep up the informative ads, because we can't buy it if we don't know about it.

Sunny Mitchell WAØPIN
R. 1
Dakota MN 55925

You should have no trouble getting into the Minneapolis repeaters if you put up a beam. Give it a try and join the fun. Alas, the $50 Life subscriptions have gone the way of the 5¢ hot dog. The doubling of the postal rates during the next year will force subscription prices upwards even more and – unless the government monopoly on handling mail is ended so efficient commercial companies can get prices down via the competition route – an unending spiral of postal rates looms ahead.

. . . Wayne

would you please let me know the component values in question?

Clayton G. Decker W2GXL
RD 1, Camp Road
Rexford NY 12148

Of course.

T1 – N-channel FET; T2 – NPN low-noise silicon; T3–T5 NPN general purpose silicon; D1–D3 – 100 PIV Silicon; D4, D5 – 50 PIV germanium; R3 should be selected according to gate-to-source breakdown voltage of individual N-channel FET.

K1CLL

I've subscribed since I got my ticket some four years ago and have always been impressed with the overall latitude of 73's coverage, especially Bill Hoisington's construction articles. Has he ever considered putting them out in a book?

Norman B. Blake WA1IVB
12 Oriole Rd.
Stoughton MA 02072

Yes, one in the works.

VHF Gain Antenna . . .

I enjoyed what there was of the article on gain antennas (73 - July 1971). As you probably have heard by now, you failed to include the cutting chart.

I might add that the velocity factor of the coax used is even more important than the length! Most 'poly-foam' types are 0.78 but there is a lot of the older stuff around which is 0.66. It is best to go directly to the manufacturer for this data, and more often than not the larger supply houses and ham stores will have that information sheet available.

I suggest that prospective builders DO NOT use the 'miniature' coax as its losses are considerable. Stick with RG/58U or larger.

ANY number of ODD ½ wavelengths can be used at position "C" in the article if antennas with more or less gain are desired. I have tried everything from a total length of about 6 ft to over 40 ft with the only difference being the extreme compres-

(Continued on News Page 6)

146.28/146.76 for the use of base stations. It also operates on 146.34/146.76 with a 2000 Hz tone for the use of mobile stations. The old tone frequency of 1250 Hz should be deleted from our previous listings.

WA7KZG is a new repeater near Chehalis, Wash. Using gain antennas at about 3325' for both transmit and receive, coverage for mobiles extends from Portland, Oregon to Tacoma, Wash. Frequencies used are 146.34/146.94 with a 1950 Hz tone burst. Units without a tone can often get into a conversation due to the repeater's 2-second-long squelch tail. Using stations are asked to wait 10 seconds after their last transmission and then to sign themselves and the repeater out.

W4JNB is the Muscle Shoals ARC repeater now operating in northwestern Alabama on 146.34/146.94. No tones.

We are totally redoing our Canadian listings. Some of the more recently noted changes and errors include VE7BEL which should have been listed with its QTH, Victoria, B.C.

The Edmonton, Alberta repeater, VE6WQ, should be listed as operating on 146.46/147.00. Simplex operation in the area is on 146.7 and 146.94.

The repeater listed as VE7ACS should now be VE7RPT. This repeater is up about 3500' on Mt. Seymour. It uses gain antenna on both transmit and receive and covers about 90 miles in all directions on 146.34/146.94. Coverage extends into a good part of Washington state.

VE7MQ and VE7APU were obviously misfiled as Washington repeaters. Similarly, the repeater listed as W7DXX on Rattlesnake Mt. appears to be an experimental extension of W7PUG. It operates with either a 146.34 or a 146.76 input for a 146.58 output. W7PUG itself is in Seattle and is now using 146.88/146.58.

W3OK should be on the air on 146.16/146.70 with 150W from Nazareth, Pa. with coverage of parts of Pennsylvania and New Jersey.

LEAKY LINES

(continued from News Page 2)

pride and jealousy as those who are devotees of gun sports?

Unfortunately the image of amateur radio in the public's estimation is much less complimentary than we would like to believe. So far as the man in the street is concerned, we are often regarded as a group of screwballs, playing around with kids' toys. We are lumped together with stamp collectors, spelunkers, model plane fans, kite flyers, bird watchers, amateur taxidermists, collectors of old hooch bottles and seashell fanciers. We rate hardly any notice at all. If a neighborhood urchin's kitten is rescued from a tall tree by the fire department, it will get full coverage with close-up pictures on page one of the local paper. But if a ham station is in action for 72 hours straight, assisting in some life-and-death situation like an earthquake, shipwreck, deadly epidemic or volcanic eruption, enabling a virtual miracle to occur through the amateur's dedication and passionate commitment to service, if it is reported at all, it will very likely turn up on page 37, opposite the tide tables and the lost-and-found!

Of course, if there is a story about TVI, this will definitely get front page coverage, accompanied by an eight column scare-head, reading, LOCAL HAM OPERATOR POLLUTES ALL TV CHANNELS. VIEWERS DEMAND IMMEDIATE ACTION. GOVERNOR RECEIVES PETITION. Perhaps I'm overstating the thing, but this is the sort of thing that happens, and it is being made abundantly clear that our stock is just about as low as it can get, so far as the general public is concerned. If you doubt this, just reflect upon the numbers of bills which have been introduced in local legislatures against the interests of ham radio. Just recall the numbers of local ordinances against antennas and towers. Just remind yourself of the million buck lawsuit against Grid, dung heap.

In the face of such incontrovertible evidence, how can any of us dare to feel free and easy about the future? And since our continued existence depends almost entirely upon our performance as a *service* dedicated to the public good, how are we going to preserve whatever esteem we may happen to enjoy, if the FCC takes away our right to participate in precisely those activities which enable us to fulfill the functions which are demanded of us?

Is there some means by which we can help convince the Commission that it ought not to limit our participation on these operations? Well, it is clear that if we wish to influence the FCC's thinking on the subject, we will not be able to do so if we do not open our mouths. We simply cannot afford to allow ourselves to be lulled into thinking that this will be done for us by someone who looks after things at long range, from Connecticut. The League will undoubtedly express some sentiment on the matter, but this does not necessarily mean that it will coincide with your ideas or mine. There will be a recommendation from ARRL arrived at after some joint discussions among the Directors and staff. But in my opinion the FCC ought to be notified by each individual amateur, speaking from his own individual point of view. The rules provide for this, as you know. And I hope sincerely that in this one instance, at least, every single amateur, whether a League member or not, will send in his comments in order to give FCC his side of the picture. Clubs should discuss their stake in the matter also, and should come to collective opinions which should be relayed to the Commission as well. We can't afford to allow a single stone to remain unturned, for the stakes are altogether too high.

Another task which is essential; there is not a periodical in this nation which does not need filler material for its columns. There is not a single

Caveat Emptor?

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Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

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THE NOVICE newsletter, articles geared to Novices, DX, traffic, Novice net activities, construction projects, more. $3. year. (monthly) Sample, stamp. 1240 21st St., Hermosa Beach, Calif. 90254.

ANNUAL FINDLAY, OHIO HAM-FEST will be September 12th at Riverside Park. Net Conferences, Flea Market, Swap-Shop, Door Prizes, Manufacturers' Display, MARS, Etc. Donation $1.00 in advance, $1.50 at park. Tickets and details from Dan Jernigan, K8VXD, Route 2, Findlay, OH 45840.

NEW MEXICO HAMVENTION 1971 will be presented 17, 18 and 19 Sept. 71, at Sheraton Motor Hotel, Albuquerque. Technical Sessions, Top Speakers, Ladies Program, Entertainment and Swapfest. Banquet on 18 Sept. For Info and Registration: NEW MEXICO HAMVENTION, Inc., Box 14381, Albuquerque, New Mexico 87111.

SALE: RCVR RCA CRM-R6A tunes 80kc to 30mc, sliderule dial, triple conversion, provision for mechanical filters, AM/SSB/CW. Cost over $1000. Best offer takes it COD. Foss, 1517 N. Main, Walnutcreek, California 94596.

WEST COAST HAMS buy their gear

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ELECTRIC ORGAN full spinet, transistorized, two manual. SASE for particulars. Lloyd G. Hanson, W9YCB, RR2, Box 52A, Angola IN 46703.

MARN Mosaic Amateur Radio Net an association of Masonic amateur radio brethren and members of the appendant Orders. Dedicated to service to mankind and international good will. Write for information. MARN 11049 Avenue E, Chicago, Illinois 60617.

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brought on the basis of a phony TVI complaint, caused by the complainant's own insistence upon using a faultily designed antenna amplifier device. These all demonstrate an all too eager willingness to relegate us to the editor who would not welcome items of public interest which reflect the participation of ham operators. Every ham should appoint himself a committee of one to bring such stories to the attention of the journalistic elements of his own area, so that a meaningful stream of source material may flow forth. This type of publicity can be extremely valuable, for it can open the public's eyes. If the man on the street is unaware of the difference between amateur radio and CB, it is our fault . . . not his. We've simply been too unconcerned to set the record straight. And we ought to make sure that this ridiculous situation is rectified at once.

There should be a central clearing agency formed in order to collate and classify all the printed material which is produced, making it available for republication, the entire country over. A file of pictorials should also be accumulated so that extracted photographs are constantly available for use in conjunction with covering stories.

There is nothing unusual or unprecedented about any of this. It is an every-day, common, garden-variety-type operation, similar to that maintained by every newspaper, magazine and press agency in the nation.

If we are compelled to do something about creating a new image for ourselves, for gosh sakes, why can't it be done on an adequate level? Must it always be on the same scale as the local garden group, the Ladies' Aid, or the boosters' club?

Recently, when I participated in a local hobby show here in Kinnelon, given in the school gym, and they wanted to sandwich my portable amateur station between a crewel embroiderer and a collector of bubble gum baseball cards, I insisted upon being given a completely sequestered position, apart from all the others, placed alone because of the comparatively more serious nature of this particular hobby . . . amateur radio. The committee acceded to my request, and the validity of this was borne out by the fact that the ham exhibit attracted more interest and attention than all the rest of the forty-odd tables put together. It was the hit of the show . . . you should have seen the looks of amazement and delight on those faces when the voices of hams from the USSR, Great Britain, Latin America and other far-flung places came booming through the speaker.

More than a dozen parents inquired about getting their kids involved in ham radio, for it had become evident that all their former ideas and misconceptions had been erroneous. All the previous rumor mongering had been discredited in this simple demonstration. And the time it took in preparation, only a couple of hours, more than justified itself in the result.

There was nothing difficult about this. Every organization is seeking such demonstrations for their programs, and will be delighted to include it. And the local editor will be just as glad to report upon it in the pages of his newspaper. I know this to be true, for I wrote a column about it for the paper for which I do a semi-weekly comment, and it was accepted without question. I invited interested readers to get in touch. A goodly number did; some are now in the process of becoming hams, and others are sending their kids. And the column, reprinted in several other periodicals in nearby towns, has brought inquiries by the score.

I once wrote in this space about a certain physician/ham who had gotten a citation from an African country in which thousands of lives were saved as a result of his shipping an antibiotic. The certificate, signed by the President of that land, stated that the doctor had done more for international goodwill and amnity than a dozen Peace Corps. This is the real function of amateur radio, and it would be tragic if a new interpretation of the regulations were to deny us the continued opportunity to serve it, as we always have.

If we can demonstrate our dedication to this principle of public service, convincing the FCC that we should be encouraged to continue, and then, if we can begin, at long last, to mount a campaign of information and orientation which will educate the hugh mass of people, then we can surely scotch all the accusations that we are nothing but idle hobbyists, playing with gadgetry and gimmickry, like a bunch of overgrown kids.

We must make it abundantly clear to the FCC and to the public at large that amateur radio is an indispensable resource . . . that the role of amateur radio is a necessary and vital one without which the public would suffer an irreparable loss . . . that it renders incalculably important service . . . is responsive to public need . . . that it stands ready to assume meaningful functions in times of catastrophe and disaster, and that therefore it must be maintained in force . . . indeed it must be encouraged to extend its areas of operation . . . not limited and proscribed and restricted to a narrow field of activity.

Let's not lose this thing by default. I hope you will withstand the temptation to neglect or postpone it. Devote a small portion of your time and energy in what may well turn out to be one of the most important issues in our history as hams. Your effort may be the tiny, little grain which will tip the scales in our favor, or which, if lacking, may result in the eventual weakening of our hobby.

Is this challenge going to go unanswered? For all our sakes, I sincerely and profoundly hope not.

K2AGZ■

LETTERS

(Continued from News Page 5)

sion of the radiation angle using the longer antenna (i.e., higher gain).

An excellent fiber glass housing can be obtained from Sears Co. in the form of a telescoping fiber glass "cane pole" in lengths of 16 and 20 ft. The things are hollow up to the tip and structurally ideal. Price varies, but the last one I got two years ago was less than $15 for the 20 ft version. The poles are also available in some of the local discount houses for less money, but the tip section is not always hollow. Shakespear is in the antenna business too, and although they have not been contacted by me as of this letter, they might provide a reasonable housing.

By eliminating the radials and 'peeling' ¼ wavelength of braid back on the feed-line a simple skirt can be used without the mounting problems of the radials. The impedance with this skirt increases from 50Ω to something over 75Ω though, and 75Ω feed-line and antenna elements should be used with the skirt type.

I agree with your findings concerning any filler material within the housing. It does not hurt the antenna to 'slop' around a little. There is definitely a problem caused by using a fiber glass filler or plastic "casting resin." Someone suggested plaster but I have never tried that . . . I suspect ANYTHING wet on the inside will detract from the antenna's performance.

Finally, Glyptal varnish just at the joints will waterproof and protect them. Clear nail polish works, too, and allow the builder to inspect the joints at a later date without damage.

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Comstock Park MI 49321

TRANSFORMERLESS power supplies

Donald Kochen K3SVC
1889 August Avenue
Dundalk MD 21222

In the past ten years, amateur radio has shifted emphasis from electron tube to solid state technology. This shift has opened new areas for innovation. Circuitry need not be converted to solid state on a one-to-one basis with the vacuum tube counterpart. Accordingly, the new generation of equipment performs more complex functions while using less components than previously possible. Old ideas can be re-examined in this light and may yield new results.

This article describes a capacitor-input, dual-voltage power supply that is suitable for low power applications. It differs from the line-operated type found in the old ac-dc radios in that the "hot" side of the line is electrically isolated, the output is voltage regulated, and efficiency is high – since the voltage is dropped across a reactive component.

Naturally the safety of such a device immediately comes to mind. Appliance shock hazard is measured in terms of a leakage current, which is that current which results when a wire is connected between ground and the appliance chassis. All appliances have *some* leakage current. In fact, any object that is even near house wiring has *some* voltage induced upon it; to demonstrate this, hook an ungrounded wire to the high-impedance vertical amplifier of a sensitive oscilloscope.

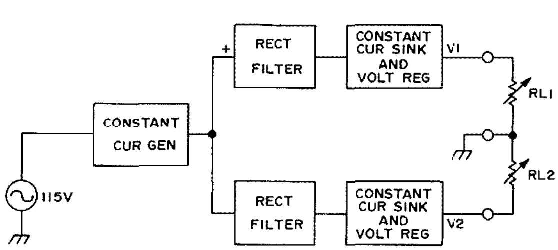

Fig. 1. Transformerless power supply.

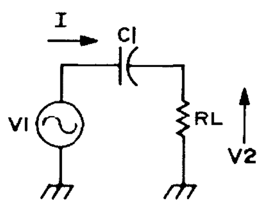

Fig. 2. Ac constant-current generator.

To be acceptable from a safety viewpoint, any leakage current must be minimized to a level consistent with current engineering practices. With this in mind, the capacitor-input power supply can take two different forms, depending on the particular application:

1) The special case, when the device to be powered is electrically insulated from all other equipment and any exposed metal chassis (such as driving a dc relay coil). In this special case the output may be allowed to "float" 115V above ground.

2) The general case, where one output terminal of the supply is electrically connected to a chassis or to some other equipment that has a chassis. In this case the capacitor-input power supply must be used either with a grounded three-conductor ac power receptacle or with an isolation transformer.

A low voltage, low current power supply can find many applications around the hamshack. Many transistorized gadgets such as preamplifiers, frequency converters, electronic keyers, and speech processors need only tens of milliamps to operate. In addition, some IC projects require both positive and negative voltage supplies.

Bench-type variable power supplies are fine for testing equipment, but it is a shame to tie them up powering miscellaneous gadgets. Aside from using a bat-

tery, the alternative is to build a separate power supply for each gadget.

Typically, a 6 or 12V filament transformer is used to build the conventional power supply. Most hams have several filament transformers in their junkbox; but they are often "boat anchor" types and are therefore esthetically unsuitable. Rather than purchase a small 1A filament transformer, a power supply can be built as outlined in Fig. 1.

As shown in Fig. 1, the 115V source is converted into a constant current genera-

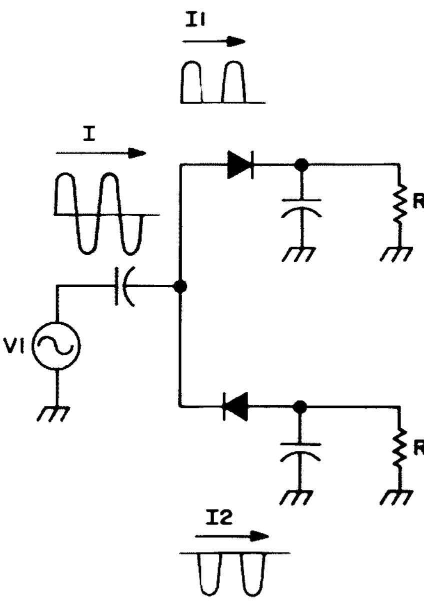

Fig. 3. Rectifier arrangement for independent positive and negative output.

tor. This ac constant current is then split and rectified into a positive and negative constant current. The dc elements are then led into a combination constant-current-sink and voltage regulator. This is a device that will draw a constant current while maintaining a constant output voltage. The purpose of the constant-current-sink is to limit the voltage at the output of the rectifier so that it will be independent of the load resistors RL1 and RL2. This relaxes the voltage tolerance of the filter capacitor. The output voltages and currents are independent of each other.

Constant-Current Generator

When a capacitor and resistor are connected in series as in Fig. 2, they will approximate a constant-current generator

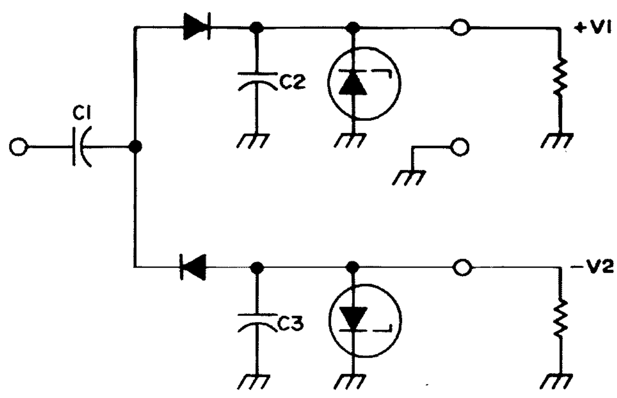

Fig. 4. A simple zener diode will provide effective regulation at loads of up to 1W.

as long as the reactance of the capacitor is much greater than the resistance. The current flow is determined mainly by the size of the capacitor and is independent of the resistor. This approximation is valid when V1 is much greater than V2. The current available is then:

$$I_{(RMS)} \cong \frac{V1}{XC}$$
$$I \cong 115\,(2\pi 60C)$$
$$I \cong 4300\ C$$

or

$$I/C\ (\mu F) \cong 40\ mA/\mu F$$

If a pair of rectifiers and filters are added to this ac constant-current generator, as shown in Fig. 3, the result is a positive current generator and a negative current generator that are independent of each other. Moreover, each generator has an average current capability of one-half the total I, or 20 mA/μF.

The maximum power delivery to the load is

$$P = (I1)^2\ RL1 + (I2)^2\ RL2$$

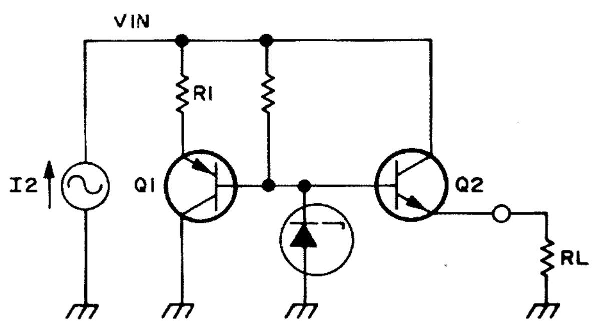

Fig. 5. At heavier loads, a transistor regulator provides better regulation and less ripple.

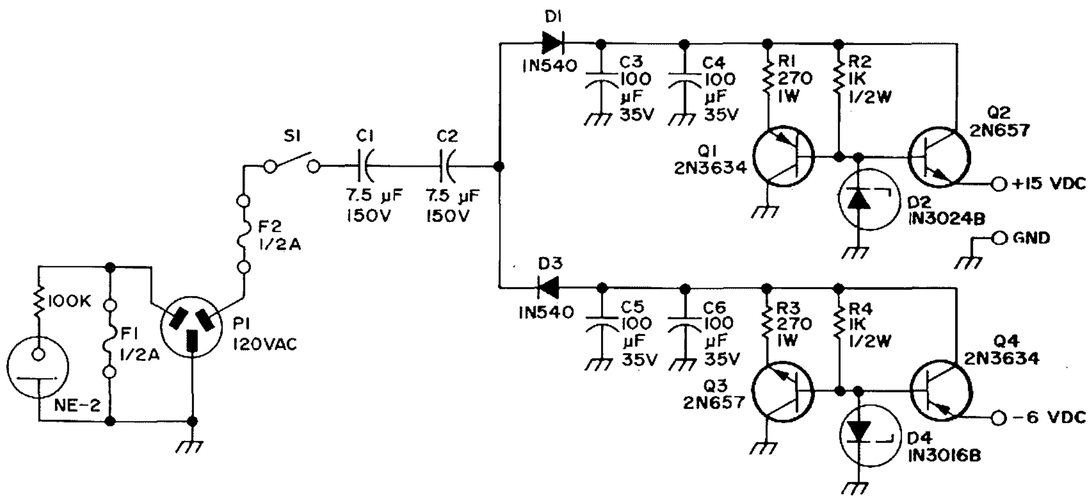

Fig. 6. Low-voltage transformerless power supply.

Voltage Regulator

The voltage regulator must draw a constant current regardless of the load; otherwise the voltage at C2 would rise up to 115V under light loading. For loads drawing less than 1W, a zener will probably suffice as in Fig. 4. But for loads drawing more than 1W, a transistorized regulator as shown in Fig. 5 will provide better voltage regulation and less ripple. When *RL* is very small, all the current *I2* goes through Q2; when *RL* is very large, all the current goes through Q1. If R1 is chosen to be equal to the smallest load resistance *RL* to be encountered, than the voltage regular will draw a constant current with no appreciable rise in input voltage.

Practical Examples

The circuit of Fig. 6 was constructed to verify performance. Note that a three-prong power plug and receptacle are required to assure a grounded output. The second ground prong is connected through a fuse to the grounded center conductor to guard against improper ac wiring. If the wiring is reversed, this fuse will disable the power supply and the neon bulb fault-indicator will light.

Asymmetrical output voltages of +15V and −6V were selected to demonstrate flexibility. At currents up to 55 mA, the −6V signal had 0.1V ripple; the +15V signal showed a ripple of 0.05V.

Note that the input capacitor must be a nonpolarized type of sufficient voltage rating. In this case, a pair of CL33s were used in series to give a voltage rating of 300V. The effective capacitance of 3.7µF in the current generator led us to expect an average output current capability of about 74 mA (= 3.7µF x 20 mA/µF).

The circuit of Fig. 7 is an example of a simple low-current supply. Again, more output current could be obtained by better filtering.

If a dual supply is not needed, one

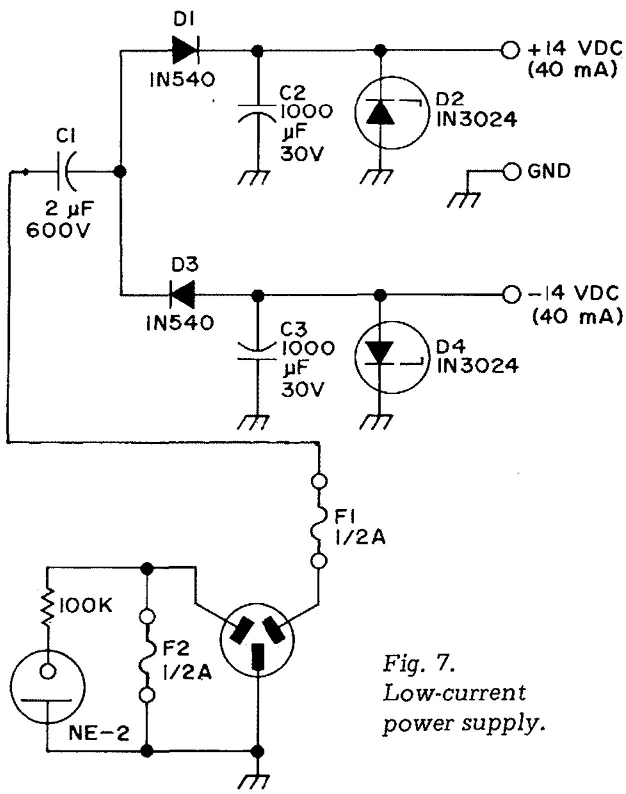

Fig. 7. Low-current power supply.

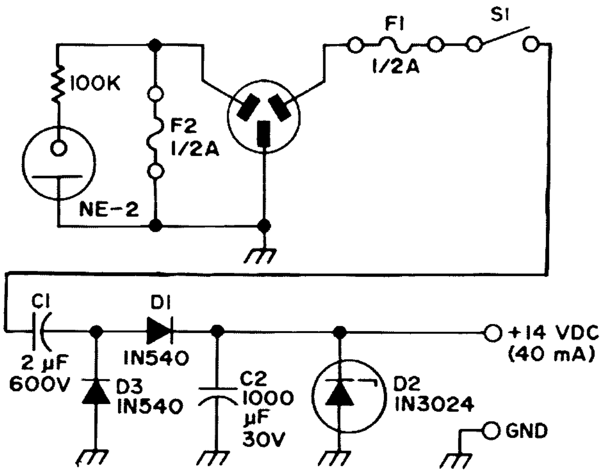

Fig. 8. Single-polarity low-current supply.

output polarity can be obtained by simply shorting one of the rectifiers to ground as in Fig. 8.

Two Conductor Wiring

Capacitor-input power supplies must be used with an isolation transformer if three-conductor ac power is not available. This becomes practical if different voltages are needed; since one isolation transformer can power several low-current power supplies. An isolation transformer can be built by the old trick of hooking two surplus filament transformers together as in Fig. 9.

Surplus dc relays are very inexpensive and are readily available at most hamfests. Their major drawback is that they usually require a 24V dc power supply. A capacitor-input power supply can be used to energize most low-power relays.

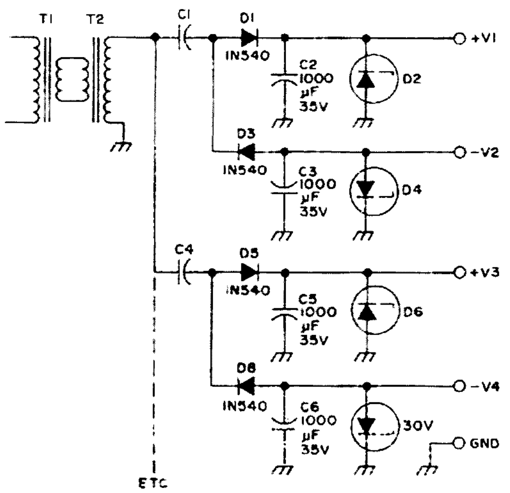

Fig. 9. Back-to-back filament transformers provide isolation where no three-wire ac is available. C1–4 are nonpolar.

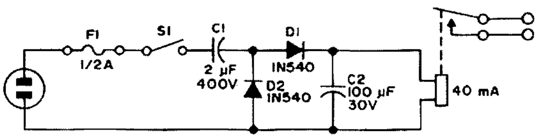

Fig. 10. The energizing switch should be at the input of the power supply, as shown. The load (relay coil) should be connected to the output of the supply at all times to limit the voltage at C2. For some relays it might not be necessary to filter the supply and in those cases C2 can be eliminated.

When powering low-voltage relays, it is usually not necessary to have a grounded output. No isolation transformer is required if the relay coil is insulated from the chassis. Figure 10 shows a typical relay power supply.

Output current an be doubled by use of a bridge rectifier as in Fig. 11. Since both positive and negative currents are utilized, the output current is 40 mA/μF of CI, or in this case 80 mA. As before, it may be found that the filter capacitor is unnecessary and may be eliminated.

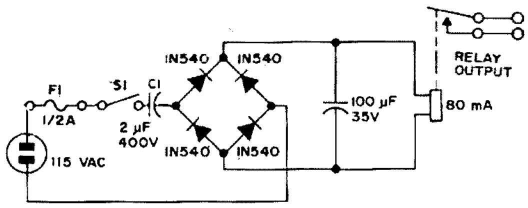

Fig. 11. A capacitor-fed bridge doubles output current capability of power supply.

Conclusion

In this article, I have attempted to illustrate various application techniques of the capacitor-input power supply, rather than give construction details for any one project. Although the circuits described are certainly reproduceable, they are presented in their simplest form and could be improved upon by better voltage regulator and filter design.

Line-operated power supplies require greater care in wiring and an understanding and respect of the potential dangers involved. If you're unsure, stick with the isolation transformer!

K3SVC■

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BUILD A SOLID-STATE MODULE TV CAMERA

I imagine almost everyone involved in electronics in this day and age has, at one time or another, wished he had a closed-circuit TV camera for one purpose or the other! Whether it be used around the home to keep an "eye" on the kids or in your business for surveillance purposes a CCTV camera can be an extremely valuable tool. While numerous assembled cameras can be purchased on the market today most of us have that ever present urge to do-it-ourselves!

If you are a little rusty on TV circuit theory, tackling a complete vidicon TV camera yourself might appear to be something more than you bargained for. But such is not the case with this construction article, since the camera we are about to describe makes use of four factory-wired modules (five, if camera is to be battery operated). These modules constitute the entire video, rf, vertical sweep, horizontal sweep, and vidicon B+ circuitry, requiring only a few simple interconnections and miscellaneous external adjustment controls.

This is the simplest and quickest approach to a TV camera that I know of that will still give a person the feeling of building it himself! The constructor can plan his own layout, cabinet to be used, plus get practical experience in assembling the vidicon focus and deflection coils and tuning up the finished camera. Through the use of camera modules, total construction time is cut drastically over a standard hand-wired project. Most constructors should be able to have their camera operating within a matter of one or two evenings.

Theory of Operation

To better understand the description that follows we suggest that you refer to the schematic diagram shown in Fig. 1.

The picture to be televised is optically focused through a lens system onto the light-sensitive target portion of the vidicon tube. The "charged" optical pattern formed on the target is then electronically scanned point by point and line by line from the back side via a sharply focused electronic beam. As the beam travels across the target current is allowed to flow through the target circuit, the intensity of which is proportional to the amount of light at that particular point. Thus the optical image is converted to an equivalent electrical signal.

To properly control the focusing of the electron beam, as well as its intensity, we must provide a means of controlling the screen voltage and the control grid bias. These are provided by the electrical focus

adjust pot and beam adjust pot shown connecting to pins 6 and 2 of the vidicon, respectively.

The signal current flowing in the target circuit, you will note, flows through a 56 kΩ resistor (target load) and then through a special 1 GΩ resistor. The change in current, as a result of the scanning beam traveling across the light and dark areas of the photosensitive target, causes a voltage drop variation in proportion to the signal current. This variation represents a very low-level video signal that must be amplified by a high-gain, low-noise video amplifier strip.

This is the purpose of the ATV Research Video Module MOD-1. It is a six-stage circuit incorporating high input impedance, 70Ω output impedance, as well as provisions for inserting vertical and horizontal sync-blanking pulses. Stable performance of the output mixer section of this module is achieved through a three-stage feedback circuit. Output of the video module is approximately 1V p-p, standard negative-going sync. The signal from this module is designed to directly drive a standard video monitor, or if desired, drive the MOD-4, a modulated rf oscillator module which makes it possible to feed a conventional TV receiver without the need for modifications.

As mentioned in the preceding paragraph, the signal current flows through the 56 kΩ load resistor and also through a special 1 GΩ resistor. The purpose of this resistor is to provide for automatic light compensation. Basically, it functions as a current-limiting circuit which tends to raise or lower the overall dc target voltage present at the junction of the 56 kΩ resistor and the 0.001 μF capacitor, depending on the average amount of light falling on the vidicon target.

The time constant provided by the 1 GΩ resistor, the .001 μF bypass capacitor, and the input capacitor (in the video module) determines the proper response time of the circuit. Light variations up to 1000:1 can be handled using this sytem without varying the sensitivity of the vidicon tube or the iris on the lens. Should variations greater than this be encountered

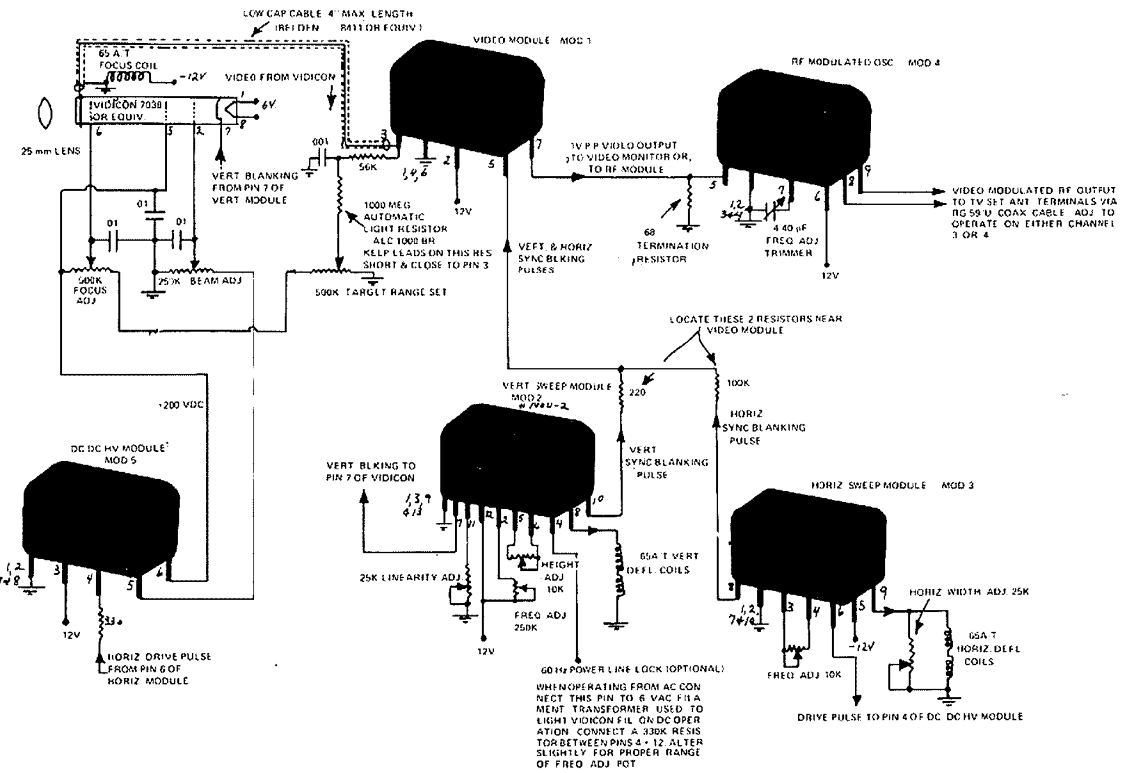


Figure 1

the vidicon sensitivity can be increased or decreased by raising or lowering the target range pot adjustment. Too high a setting of this control will result in excessively contrasty and distorted video while too low a setting will result in washed-out pictures.

Many CCTV users do not have access to a video monitor in which the video output from the camera can be fed directly into the video amplifier of the monitor. Therefore, quite a few users prefer to make use of existing TV receivers; although it is possible to modify these sets to accept the video output from the camera directly into the first video amplifier stage, it is not generally a popular practice. In the first place, many of the present-day receivers are ac/dc devices that present a serious shock hazard when connecting the ground of the set (actually one side of the power line) to another piece of equipment . . . in this case the TV camera. Second, most constructors are not familiar enough with the set to perform the necessary modifications without considerable trouble. Some sets require a video polarity inverter stage, others simply don't have sufficient gain to function properly. Consequently, in these cases, the rf modulated oscillator (MOD-4) is used.

The MOD-4 is a single-stage oscillator incorporating a fixed printed circuit tank coil externally tuned via a 4–40 pF trimmer. Operation is on either of two adjacent low-band channels, depending on which one is vacant in your area. Video from the video module is fed to the oscillator to effectively modulate it, providing a modulated rf output signal that can be received by any standard TV receiver. The 68Ω terminating resistor provides the proper load for the output circuit of the video module and must not be forgotten. (When using the video module to directly feed a video monitor this 68Ω resistor is located at the monitor . . . not at the camera.) Slight alteration of this resistor affords the constructor the opportunity to increase or decrease the modulation level over a moderate range in order to obtain the best possible picture. It's not recommended that a value lower than 39 Ω or higher than 120Ω be used.

Vertical and horizontal sweep, required to deflect the vidicon electron beam up and down and across is obtained by the

vertical module (MOD-2) and the horizontal module (MOD-3). Both of these units consist of a blocking oscillator, buffer stage, and output stage. These two modules, together, constitute a complete sync and blanking generator as well as the sweep amplifiers. Both modules allow for external adjustment of the frequency and sweep amplitudes.

In the case of the vertical module, external adjustment of the sweep linearity is also provided . . . this not being required on the horizontal module. The vertical blanking signal feeding the cathode of the vidicon is required to prevent vertical retrace lines from appearing in the televised picture during the periods the beam is returning from the bottom of the target to the top. For technical reasons of little interest, this is not necessary for the horizontal retrace. Both modules also provide a combination sync-blanking pulse which is mixed with the video in the video module to form a composite signal capable of locking the scanning oscillators in the TV receiver.

When the camera is to be powered from the 120V power line it is important to lock the vertical sweep module to the frequency of the power line by connecting line lock pin 4 to one side of the 6V feeding the vidicon filament. In this manner, any residual hum, either in the camera or in the TV set, will appear stationary on the screen rather than "crawling" through the picture.

As can be seen from the schematic, the entire camera can be operated from a low-voltage source of approximately 12V, tapping half way to provide the 6V required to operate the vidicon filament. The only other voltage required is the 200V which can be obtained one of two ways. If it is desirable to operate from the power line, the B+ as well as the low voltages required can be obtained from a transformer supply. A typical recommended circuit is shown in Fig. 2.

Another approach would be to build only the 12V portion of the recommended supply using two 6.3V filament transformers in series. These transformers are readily available from a multitude of electronic distributors and provide a simple means of obtaining the required low voltage. The B+ can then be obtained with the dc-dc B+ module (MOD-5). This is an interesting approach to obtaining the 200V since it takes a drive pulse from the horizontal module, amplifies it, then rectifies and filters it all without the use of

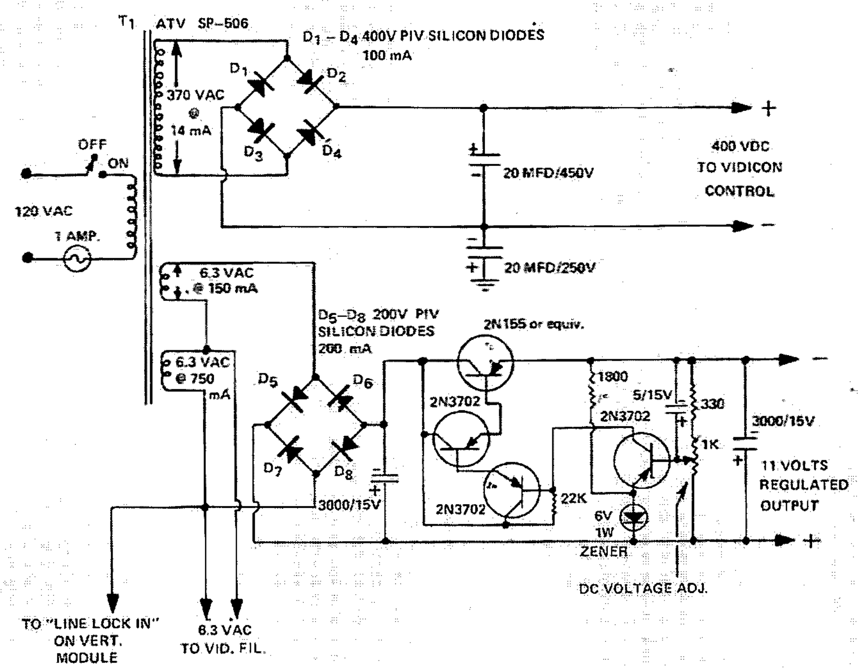
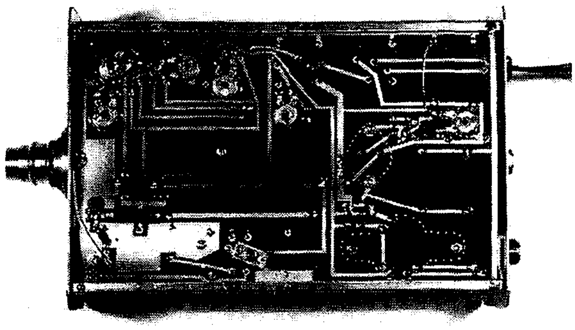


Figure 2



Bottom inside view of camera shows pots and other misc. parts mounted on a master PC board. Note parts are mounted on copper side of board except those related to power suply. This is done to conserve space.

heavy, bulky components. Since the ripple frequency is that of the horizontal sweep (15.75 kHz), very small filter capacitors can be used, thereby keeping the size very small. Of course, the dc-dc module is invaluable for providing the B+ when building a camera to be completely battery operated.

Vidicon Electromagnetic Focusing/ Deflection System

Thus far no mention has been made of the manner in which the vidicon is electromagnetically focused or deflected; the prime concern to this point has been the modules themselves. However, to fully understand the operation of the camera, you should spend a few moments to become familiar with this phase of the camera also. Since the camera modules have been designed to incorporate the most economical and the most readily available vidicon tubes (namely the 1 in. diameter electromagnetically focused and deflected types such as the 7038, 7735A, 6326A), it is only natural that it be designed to accept presently available focus and deflection coils.

A detailed description on assembling this portion of the camera is not necessary since the instructions provided with the kit of coils is quite adequate. Briefly, however, the vertical and horizontal deflection coils are mounted on a form large enough in diameter to allow the vidicon to slip into it. This assembly, known as a yoke, fits into the focus coil which envelops the entire front end portion of the tube. The vidicon target ring seats into the target connector located in the front end of the focus coil.

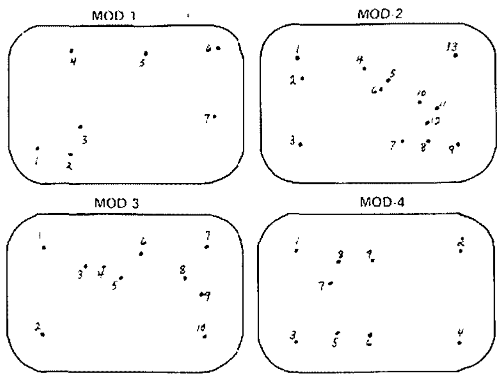
The first question that usually comes to mind involves the use of a focus coil: Isn't the tube electrostatically focused? Yes, it *is* electrostatically focused – but it is also electromagnetically focused. The vidicon tube incorporates a unique low-velocity scanning system and requires an axial magnetic field to produce a one-loop spiral path from the electron gun to the target. This is produced via the external focus coil. Fine adjustment is provided by the electrostatic focus adjust pot which varies the voltage on the grid (pin 6) of the tube.

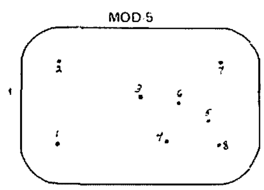
General Hookup Instructions

Whether you are using all five of the modules to build your TV camera or just some of them, keep the following points in mind.

Always be certain you make the correct connections to the proper pins; otherwise serious damage may result to the module!

Use the schematic diagram shown in Fig. 1 and the module pin layouts shown in Fig. 3 to determine the proper connection of the pins to the rest of the circuitry and to the other modules.





MODULAR COLOR CODE

MODULE	COLOR
VIDEO MOD 1	BLACK
VERT. MOD 2	YELLOW
HORIZ. MOD 3	GREEN
R.F. MOD 4	RED
H.V. MOD 5	ORANGE

Figure 3

Double-check all connections before applying power.

Locate the video module near the front of one side of the focus coil to allow a short lead to connect from it over to the target connector. Place the rf module near the rear of the focus coil on the same side. Place the vertical module on the opposite side of the focus coil near the front and the horizontal module on the same side, near the rear of the focus coil. The B+ module can be placed near the back of the camera close to the horizontal module. As in all good engineering, keep leads short and direct.

Extra grounds have been provided on each of the modules. These can generally all be grounded; however, in certain instances, depending again on individual construction layout and wiring practices, this may result in a ground loop being formed. Most often this will occur in the video amplifier stages since this is an extremely high-gain unit. When it happens, most often it will result in a self-oscillation. By removing one or more of the grounds and grounding them to different points on the chassis, this condition can be quickly and easily corrected.

Science students and other experimenters desiring to breadboard the camera for demonstration or lab purposes should keep one more thing in mind. The front of the vidicon is extremely sensitive to rf signals such as those radiated by local AM broadcast stations. If you are planning a

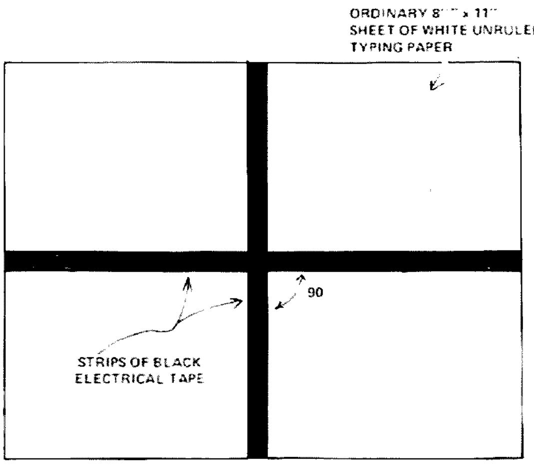
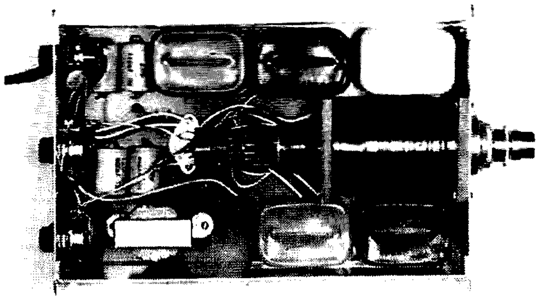


Figure 4



Top inside view of camera showing the lens, lens mount, focus-deflection coil assembly, vidicon tube, power supply to rear and the five modules. The module order is; from front to back: Video module and RF module on the side with the power transformer; Vertical module, horizontal module and HV module on opposite side. Power supply filter capacitors, transistors and rectifiers are shown occupying the rear portion of the camera. Beam, focus and target pots shown on rear panel.

breadboard camera be sure to use a metal panel for at least the front end of the camera for mounting the focus coil and lens. This panel should also fold back to shield the video module . . . otherwise rf interference might render the camera inoperational. Total shielding of the front end of the camera is not usually required, except in high interference areas, but at least partial shielding is always required.

Both link output coupling and capacitive coupling have been provided on the rf module. The schematic shows it hooked up for link. However, depending on the TV set used and length of line, the capacitive coupling may provide the best picture. In this case connect the TV set to terminals 2 and 9 rather than 8 and 9.

Deluxe installations may desire switchable video and rf outputs. This is entirely practical. Just remember to keep leads short and direct.

Tuneup Instructions

Tuning up the camera is really easy if you will simply follow the procedure outlined below;

1. Begin by setting the beam pot to maximum negative voltage; the target pot to +80V; focus pot to +110V; horizontal width to maximum resistance; horizontal

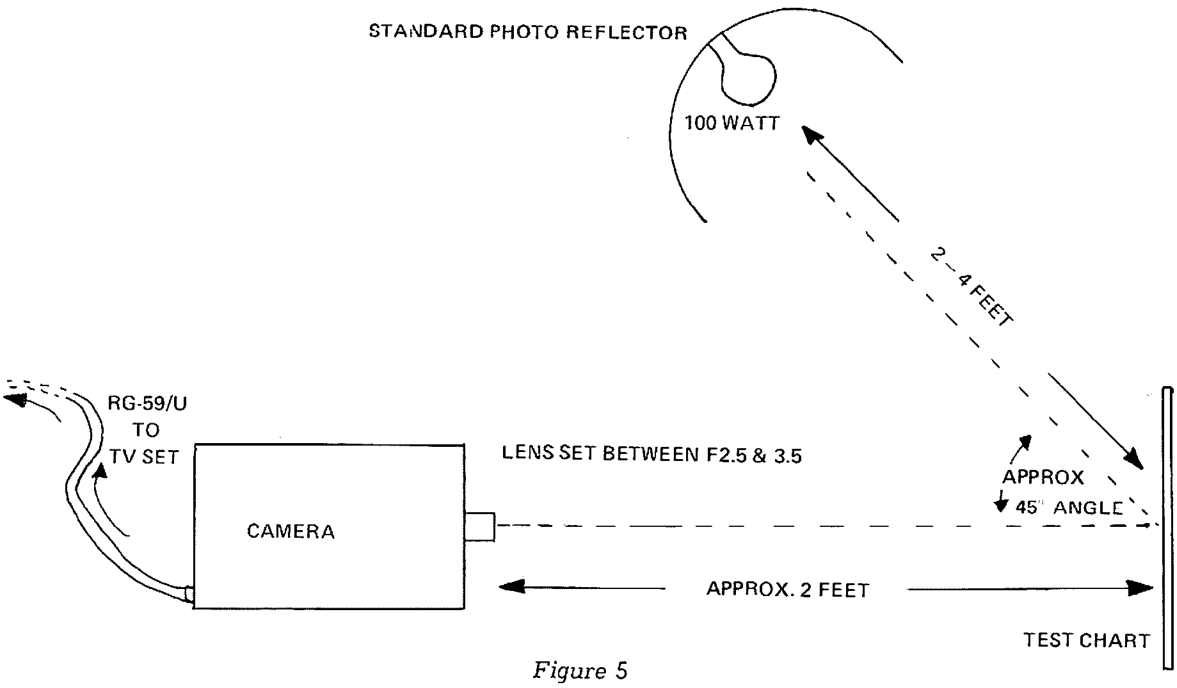


Figure 5

and vertical frequency pots to mid-range; vertical linearity pot to maximum resistance; vertical height pot to minimum resistance; and, if used, the regulated dc adjust pot in the ac power supply to mid-range.

2. Make a simple test card by attaching ordinary black electrical tape to an 8½ x 11 in. sheet of white paper. (See Fig. 4.) Place one piece of tape horizontally across the center of the paper. Place the other piece vertically across the paper thereby forming a + pattern. This pattern is a preliminary test aid only; it is used only for initial setup adjustments.

3. If a video monitor is used, connect the output of the video module to the input of the monitor. If a conventional TV set is used connect the output of the rf module to the antenna terminals of the set using RG-59/U cable. It makes no difference which terminal you use for the outer ground braid. When connecting to a TV monitor be sure the terminating resistor is located at the monitor and not at the camera!

4. Before turning on the camera, tune in a local broadcast station on your set and make all necessary horizontal and vertical hold adjustments. Also, remember, the linearity of your camera can be no better than that of the monitor. Therefore, be sure the height and linearity controls on the TV set are properly adjusted before proceeding with the camera tuneup. Some stations still transmit a short period of test pattern in the morning prior to regular broadcasting. This is very helpful in setting up the receiver.

5. Turn on the power and allow about 1 minute for the vidicon heater to reach operating temperature. *Do not advance beam pot! Keep beam grid at maximum negative voltage!*

6. Set the regulated DC ADJ pot in the regulated power supply (if used) for −11V. Even though the schematics show −12V, in actuality it is −11V when using the recommended regulated supply. If batteries are used, the value can be anywhere between 9 and 12V with best operation being obtained when operating near the higher voltage.

When using batteries, it is necessary to connect between 1000 and 3000 μF across the battery to prevent feedback problems between modules as the batteries age and their internal resistance increases. An alternate approach to this feedback problem would be to use a separate battery to power the video module. Even then, however, a few hundred microfarads of bypass capacity would be advisable to prevent possible trouble as the battery ages.

7. If the rf output module is being used, set the TV receiver to either of the two

operating channels depending on which one is vacant in your area. Adjust the 4–40 pF trimmer until black sync bars appear on the screen. Next, adjust the horizontal frequency pot to lock the horizontal oscillator to the TV receiver.

8. Now adjust the vertical frequency pot until the vertical oscillator is locked to the TV set.

9. Uncap the lens and slowly begin to advance the beam pot (decreasing the negative bias voltage on grid 1 of the vidicon) until a "wiping" effect occurs across the screen. You should now see something that resembles the + chart. For this test, camera-to-chart distance should be about 2 ft and about 100W of illumination 2–4 ft away on a 45° angle, should be used (see Fig. 5). No doubt the picture will be quite poor at this point . . . badly distorted, etc. This is normal since the sweep adjustments have yet to be accurately set.

10. Grasping the rear end of the yoke form, notice that a slight up and down movement of the yoke will cause the scanned target image to shift position on the monitor screen. Insert the necessary shims between the yoke and focus coil until the raster is centered both vertically and horizontally on the monitor screen. Be sure to shim sufficiently to provide a tight fit between the yoke and the focus coil, in order that correct orientation is maintained no matter what position the camera will be operated in.

11. Now adjust the vertical height and linearity pots until the target image just fills out the monitor screen and is as linear as possible. Correct sweep is indicated when the edges of the screen are just filled out with the picture, that is, until no signs of the edges of the vidicon target appear in the televised picture. To determine best linearity, tilt the camera up and down while observing the width of the horizontal test pattern bar. It should remain essentially the same size from the top of the screen to the bottom.

12. Next, adjust the horizontal width pot until the height-to-width ratio appears proportionate. This can be touched up later with the aid of a circle pattern, adjusting for the best shape.

13. All the tests should have been performed with the lens iris at approximately f2.5 or f3.5. To this point, quite likely results have been considerably less than ideal. But don't be alarmed. When setting up a camera the first time, it is difficult to get good results right off due to the number of adjustments required. However, in the next couple of steps picture quality should improve tremendously, resulting in a TV signal approaching the quality you are accustomed to viewing on regular broadcast TV.

14. Adjust the lens focus for sharpest image then adjust the focus adjust pot next for the sharpest image. Recheck the beam pot again to make certain it is correctly set to *just* discharge the entire scanned target. Insufficient discharging will result in washed out highlights. Excessive beam current (decreasing negative bias too much) will result in defocusing, poor shading, and possible damage to the vidicon if left uncorrected too long.

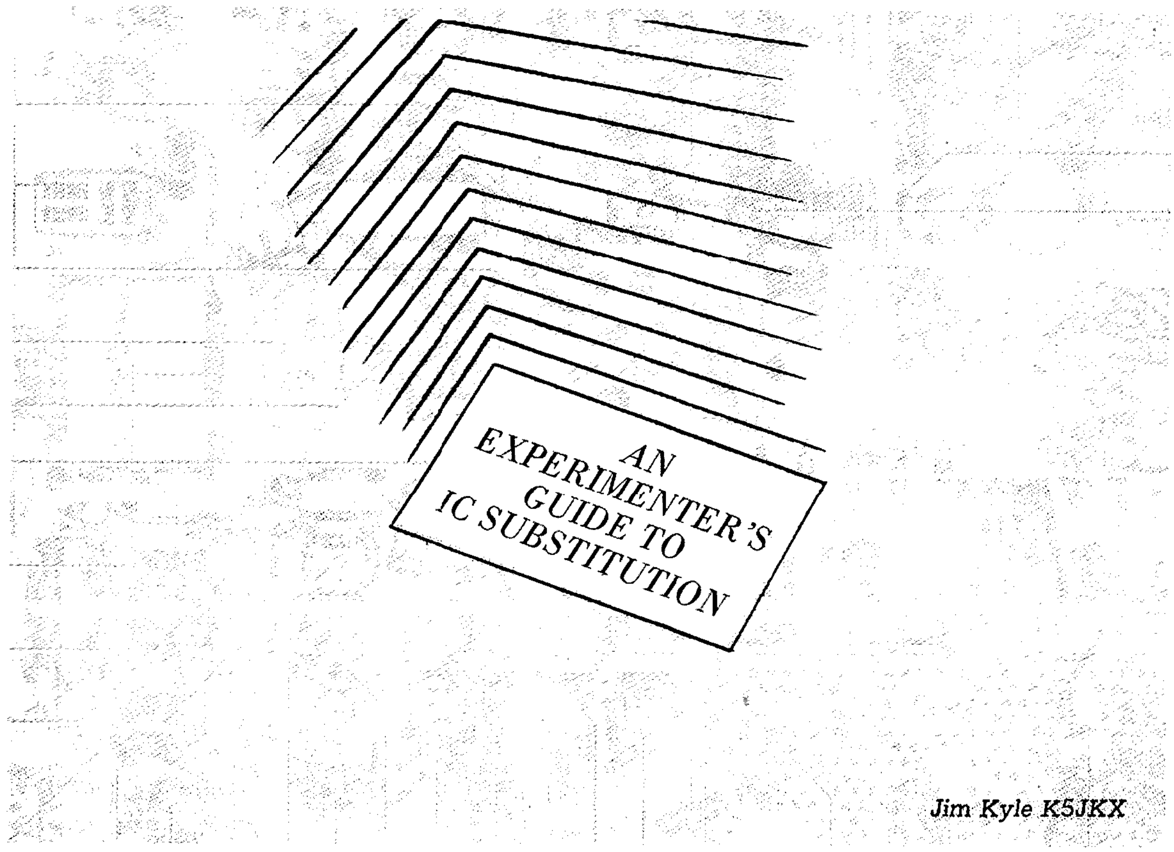
15. If the picture tears, pulls, or goes out of sync it is probably due to excessive target voltage or incorrect adjustment of the rf oscillator 4–40 pF trimmer. Check both adjustments and set for best performance. Too low a target setting will result in low-contrast pictures, so don't go any lower than necessary to obtain a good stable signal.

16. Should the picture appear tilted, upside down, or inside out make the following alteration to the deflection yoke: If picture is tilted, rotate the yoke slightly while monitoring results on the TV set. If picture is upside down or backward, reverse the vertical or horizontal leads until a "right-reading," right-side-up picture is obtained.

17. Upon completion of step 16 it may be necessary to make minor corrections on the yoke shims for correct centering of the target scan.

18. Now go back and repeat the adjustments. The second time around goes very quickly and is well worth the added effort.

You should now be ready to enjoy many trouble-free hours of televising, using the solid-state module TV camera you have successfully built. . . .WØKYQ■



As the insiduous integrated-circuit chip makes its way ever deeper into the heart of electronics, more and more construction articles are devoted to IC projects. While some purists (probably the same ones who used to build their own vacuum tubes) may object to this trend, it's probably all for the better – because the ICs result in more uniform and predictable circuits and permit us to homebrew devices which only a few years ago were simply too much trouble for any but the most dedicated of homebrewers.

But there *is* one thing wrong with ICs: there are just too many different kinds of them on the market. The same thing is going on that happened when vacuum tubes made their debut, and much more recently with transistors. Every different manufacturer has his own set of identification numbers, and most of the IC makers concentrate on original-equipment-manufacturer sales so that their products are not the easiest of things to find in the neighborhood parts house.

This means that many worthwhile projects simply never get built by many of us, because the particular IC which is at the heart of the project is difficult for us to obtain.

Fortunately, at least one major manufacturer of ICs has recognized this problem, and is marketing a much-simplified portion of his product line to hobbyists, experimenters, and professionals through the standard parts-house outlets.

What's more, every one of the ICs in this line can substitute for several other types of ICs in both the manufacturer's regular product series, and those of other IC makers. All that's necessary, then, to make many projects feasible is a cross-reference table (like the popular transistor-substitution books) – and that's what this article is all about.

The manufacturer involved is Motorola, and the product line is called "HEP" (for *hobbyist, experimenter, professional* – the three classes of users for whom the line is intended). The HEP line contains many semiconductors in addition to IC chips, but here we're interested only in the ICs. Since additions to the line are constantly being made, this may not cover all HEP ICs by the time it reaches print, but it does

describe all which are in catalog HMA 35 (released in mid-1970).

Four classes of ICs are included: three of these are *digitals* or computer-type circuits, and the fourth is *linears* or amplifier circuitry.

The three families of digital ICs include one group of emitter-coupled logic units and two groups of "TRL" devices; the two families of RTL are "milliwatt" and "medium power" units.

Most published circuits using digital ICs are built around medium–power RTL devices, since the first inexpensive such ICs were in this family.

The four families in the HEP line are: HEP 553, HEP 554, HEP 556, and HEP 558, emitter-coupled logic digitals?s; HEP 570, HEP 571, HEP 572, and HEP 584, medium-power RTL; HEP 580, HEP 581, HEP 582, and HEP 583, milliwatt RTL; and HEP 590, HEP 591, HEP 592, and HEP 593, linear.

We won't go into the ECL (553–558) very deeply, since ECL logic circuits differ somewhat from the more familiar ones.

In RTL, the 570–572 are 14-pin dual-inline packages (DIPs) and the 580–584 are in 10-lead TO-5 transistor cans (HEP 453 is the flatpack socket, while HEP 451 fits the 10-lead units).

The HEP 570 is a quadruple 2-input *nor* gate (four identical 2-input gates in one package but electrically independent). The HEP 571 is a dual buffer. The HEP 572 is a dual J–K flip-flop.

The HEP 584, final member of this medium-power RTL family is a dual 2-input *nor* gate, equivalent to halfof a HEP 570.

The HEP 580 is a dual 2–input *nor* like the HEP 584 except that the 580 is a milliwatt unit requiring, and producing, less power. The HEP 581 is a 4–input *nor* while the HEP 582 is a dual buffer but has two inputs to each buffer permitting it to be used as a dual 2–input *nor* also. (The 581 has an inverter built in which permits it to be used as a 4–input *nor* also.) The final member of the milliwatt RTL family, the HEP 583, is a dual J–K flip–flop.

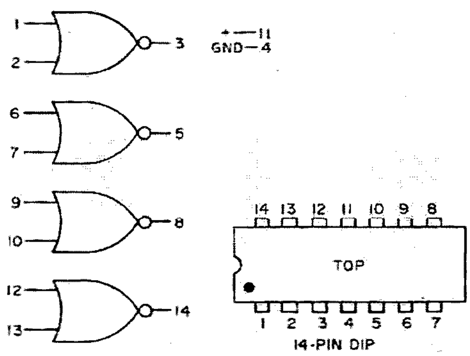
The linear circuits include a high–frequency rf/i–f amplifier with noise figure of 5 dB at 60 MHz and gain of 30 dB (HEP 590), a combined amplifier – discriminator for FM i–f use (HEP 591), a stereo preamplifier with two separate high–gain audio amplifiers and external equalization of frequency response (HEP 592), and a 1W power amplifier (HEP 593).

To make it simple to use these units to replace other types of ICs which may be called for in various projects, we've prepared a series of charts which show the pin connections for each, together with certain key characteristics such as maximum voltage and required current, and a listing of the other IC types which the HEP unit can replace. Interchangeability information is taken from data published by Motorola.

Frequently, several HEP units may be shown as being interchangeable with the *same* type of IC. For instance, both the HEP 584 and the HEP 570 show interchangeability with the Fairchild uL914. This comes about because the interchange works only one way; the 584 is an exact substitute, while the 570 has twice as many elements in a different case.

HEP 570

BASE DIAGRAM:



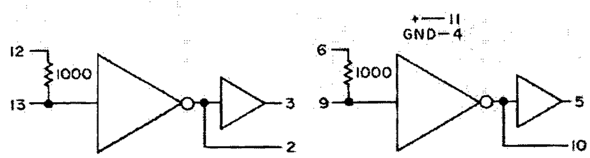
Maximum signal voltage: ±4.0V
Maximum supply voltage: †12V
Operating temperature range: +15 to +55°C
Output current: 2.65 mA per gate element
Package: 14-pin dual inline (socket HEP 453)

REPLACES:

Motorola	MC717P (requires more power)
	MC724P
	MC817P (temperature range is smaller)
	MC824P (temperature range is smaller)
Fairchild	uL914 (570 has four gates, 914 only 2, and package is different)
	U5B991429X (570 has 4 gates, U5B991329X has only 2)

HEP 571

BASE DIAGRAM:



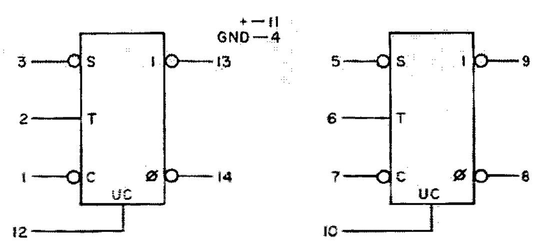
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55e +55°CC
Package: 14-pin dual inline (socket HEP 453)

REPLACES:

Motorola MC799P	
	MC899P (temperature range is smaller)
Fairchild	uL900 (571 has 2 units, 900 only one)
	U5D990029X (two units instead of one)
Other	PL990029 (two units instead of one)

HEP 572

BASE DIAGRAM:



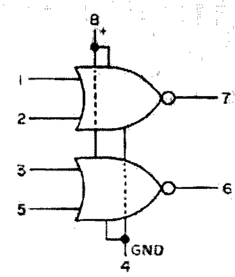
Maximum signal voltage: ± 4.0V
Maximum supply voltage: + 12V
Operating temperature range: +15 to + 55°C
Package: 14-pin dual inline (socket HEP 453)

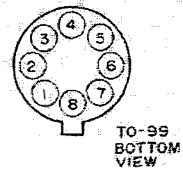
REPLACES:

Motorola	MC776P (requires more power)
	MC790P
	MC876P (smaller temperature range)
	MC890P (smaller temperature range)
Fairchild	uL923 (two units instead of one)
	U5B992329X (two units instead of one)
Other	PL992329 (two units instead of one)

HEP 580

BASE DIAGRAM:





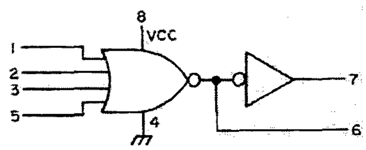
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55°
Package: TO-99 (8-lead transistor-sized, socket HEP 454)

REPLACES:

Motorola	MC710G
	MC810G (smaller temperature range)
	MC910G (smaller temperature range)
	MC710F (different package)
	MC810F (different package, smaller temp. range)
	MC910F (different package, smaller temp. range)
TI	SN17810L (smaller temperature range)
	SN17910L (smaller temperature range)
Fairchild	U5B991021X
	U5B991029X
Other	PL991021 (smaller temperature range)
	PL991029

HEP 581

BASE DIAGRAM:



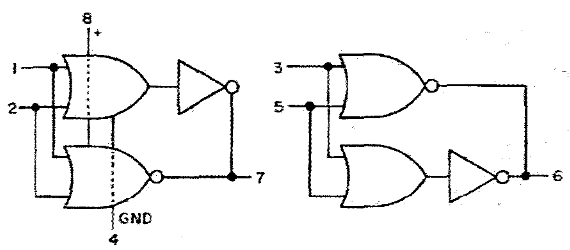
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55°C
Package: TO-99 (socket HEP 454)

REPLACES:

Motorola	MC711G
	MC711F (different package)
	MC811G
	MC811F (different package)
	MC911G (smaller temperature range)
	MC911F (different package, smaller temp. range)
TI	SN17811L (smaller temperature range)
Fairchild	uL911 (lower power ratings)
	U3F991129X (different package)
	U5B991129X
	U5F991121X (different package)
Other	PL991129

HEP 582

BASE DIAGRAM:



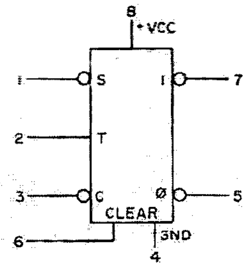
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55°C
Package: TO-99 (socket HEP 454)

REPLACES:

Motorola	MC781G
	MC881G (smaller temperature range)
	MC981G (smaller temperature range)
Fairchild	U5D990029X (lower power ratings)

HEP 583

BASE DIAGRAM:

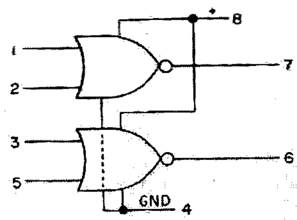


Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55°C
Package: TO-99 (socket HEP 454)
REPLACES:

Motorola	MC782G
	MC882G (smaller temperature range)
	MC982G (smaller temperature range)
Fairchild	U5B992329X (lower power ratings)
	uL923 (lower power ratings)
Other	PL992329 (lower power ratings)

HEP 584

BASE DIAGRAM:



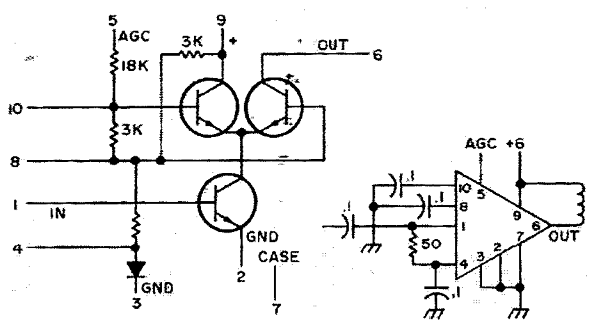
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to+55°C
Package: TO-99 (socket HEP 454)
REPLACES:

Motorola	MC714G.
	MC714F (different package)
	MC813G (smaller temperature range)
	MC814F (different package, smaller temp. range)
	MC914F (different package, smaller temp. range)
Fairchild	uL914
	U3F991421X (different package)
	U3F991422X (different package)
	U5B991421X
	UB5991422X
	U5B991319X
Other	PL991429

HEP 590

BASE DIAGRAM:

Maximum signal voltage: 5V rms
Maximum supply voltage: +20V
Operating temperature range: –55 to +125°C
AGC supply voltage (max.): 20V
Supply current: 2.5 mA dc
Package: 10-lead TO-5 (socket HEP 451)

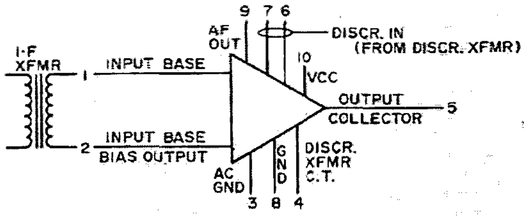


REPLACES:

RCA	CA3002
	CA3003
	CA3004
Motorola	MC1550G
GE	PA713
	PA7601
Fairchild	U5D770339X

HEP 591

BASE DIAGRAM:



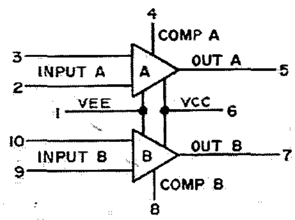
Maximum signal voltage: ±3V p-p
Maximum supply voltage: +10V
Supply current: 27 mA max., 12 mA min.
Operating temperature range: –55 to +125°C
Typical voltage gain: 60 dB min.
Package: 10-lead TO-5 (socket HEP 451)

REPLACES:

RCA	CA3013
	CA3014
Motorola	MC1314G

HEP 592

BASE DIAGRAM:



Maximum signal voltage: ±2V p-p
Maximum supply voltage: +16V pin 6 to pin 1
Voltage gain (each channel): 10,000 typical
Output voltage swing: 4.5V p-p min., 5.5V p-p typical
Operating temperature range: 0 to +75°C
Package: 10-lead TO-5 (socket HEP 451)

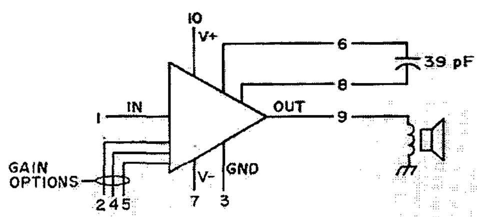
REPLACES:

Motorola	MC1302G
	MC1302P (different package)
	MC1303P (different package, differnt power level)

May replace type 709 opamps with modifications of compensation network values; each 592 is equivalent of two 709s.

HEP 593

BASE DIAGRAM:

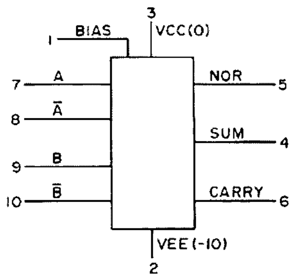


Maximum signal voltage: not rated; has 3–way gain option
Maximum supply voltage: 18V
Supply current: 15 mA max. (no signal), 0.5A (peak signal)

Audio output power: 1.8W
Operating temperature range: −55 to +125°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	MC1554G

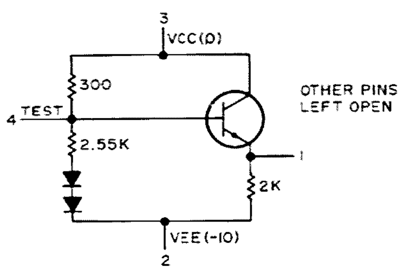
HEP 553
BASE DIAGRAM:



Maximum signal voltage: −10V
Maximum supply voltage: −10V
Operating temperature range: +15 to +55°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	MC303G
	MC303F (different package)
	MC353G
	MC353F (different package)
Other	SW303F (different package)
	SW303T
	SW353F (different package)
	SW353T

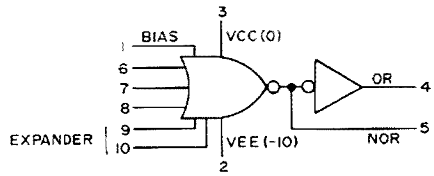
HEP 554
BASE DIAGRAM:



Maximum supply voltage: −10V
Operating temperature range: +15 to +55°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	MC304G
	MC304F (different package)
	MC354G
	MC354F (different package)
Other	SW304T
	SW304F (different package)
	SW354T
	SW354F (different package)

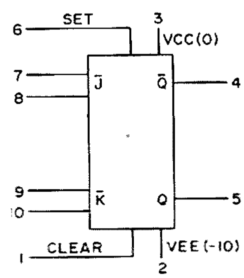
HEP 556
BASE DIAGRAM:



Maximum signal voltage: −10V
Maximum supply voltage: −10V
Operating temperature range: +25 to +55°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	MC306G
	MC306F (different package)
	MC356G
	MC356F (different package)
Other	SW306T
	SW306F (different package)
	SW356T
	SW356F (different package)

HEP 558
BASE DIAGRAM:

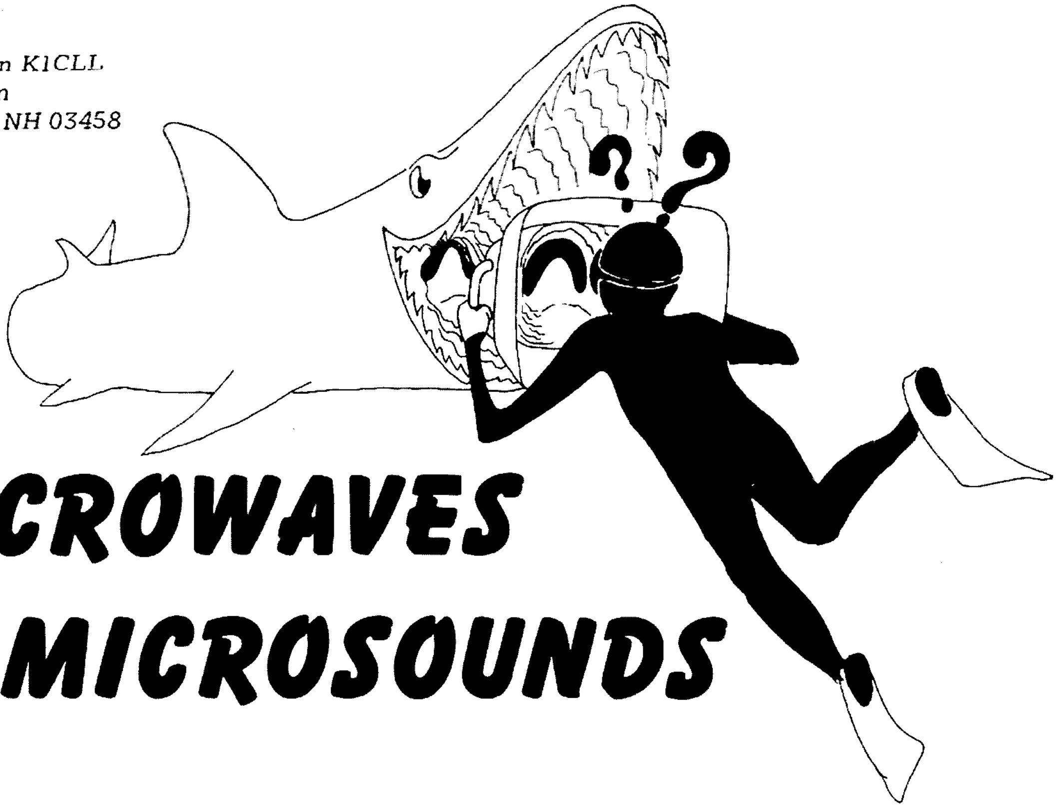


Maximum signal voltage: −10V
Maximum supply voltage: −10V
Supply current: 21mA
Operating temperature range: +15 to +55°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	MC308G
	MC308F (different package)
	MC358G
	MC358 (different package)
Other	SW308T
	SW308F (different package)
	SW358T
	SW358F (different package)

. . . K5JKX■

Bill Hoisington K1CLL
Far Over Farm
Peterborough NH 03458



MICROWAVES & MICROSOUNDS

Those of you who have been following my articles in 73 know that I am, basically, a tinkerer. I love to take a new component and see what I can do with it. It may be a 432 MHz oscillator using a 30¢ transistor or it may be 3000 MHz. It can even be down in the sound wave region of things.

Microwaves are very similar to sound waves, oddly enough. The wavelengths are about the same, in case you never stopped to think about it. Thus acoustical devices may often have their microwave counterparts, and vice versa.

The other day, while doing some work on a little scheme of mine called "Radeye," a sort of microwave eye for seeing through fog, I suddenly got to wondering if the same basic idea might not be adapted to the sound spectrum and applied as an underwater sonic eye or "Soneye."

The sound waves and techniques used to see underwater in this new system show striking similarities in "antenna" (lens) size, beamwidths, refractive index, gains, signal frequencies and amplifiers, and in the viewer, to the electromagnetic waves and methods used in microwave viewing systems.

It is considered that many amateurs will be interested in the basic electronics common to both these fields of scientific endeavor, related as they are to amateur radio.

Basic Soneye

In order to actually see underwater by sound waves you need a source of sound waves in the water, a receiver for these waves, preferably using an underwater lens which will produce an image, and a transducer, sound waves to light waves, so the pilot or scuba-diver can see where he is going and what he is doing, even in dark or muddy water.

Sound waves useful in Soneye run from very short waves of less than an inch and frequencies up near a megahertz for close-in work a few feet away, to much longer waves going down to as low as the audible range for underwater vision out to a mile or so.

These may be of the following types. Note that each time the word "light" is used it means underwater illumination by sound waves.

1. Beacons, underwater "lighthouses," tail lights, channel markers, anti-collison lights, etc. These sources have their own power and operate completely independent of any receiver. When used, they form a one-way system of direct lighting. CW

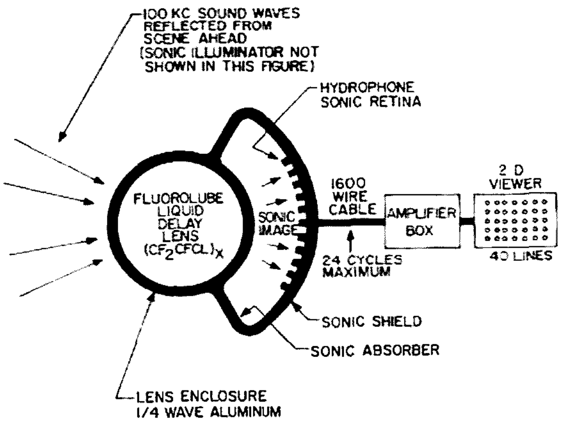


Fig. 1. Basic Soneye.

(continuous wave) is used, and no synchronism is needed between source and receiver.

2. Indirect lighting. This type of underwater sound illumination is similar to ball-park floodlighting, or flares as used in battle areas. It is not necessarily near the desired object or scene, nor is it necessarily near the viewer. It is semi two-way. Again, it is CW and no synchronism is needed.

3. Headlight, or flashlight type of underwater sound illumination. These sources are carried by the user and are therefore close to the receiver, as the headlights of a car or a hand-held flashlight. CW may be used, or pulse, if three dimensional vision is required.

The underwater sound is generated by one or more oscillators connected to one or more transducers. A transducer changes electrical waves to soundwaves like a loudspeaker, although generally it is made of ceramic and is in direct sonic contact with the water.

Methods of sonic illumination:

A. In the simplest form one transducer would be used, like a flashlight bulb. It could be broad or narrow beamed.

B. More than one transducer could be used, in which case they would be placed in back of a liquid underwater lens and each transducer would benefit from the full gain of the lens.

C. A large number of transducers could be used in back of a large lens with each transducer again having the full gain of the lens, to project a sharply defined image ahead for special purposes. Large area powerful sonic illumination for searching would be one of these purposes. It is interesting to note that no phase requirement exists with such a powerful illuminator. This is one of the lens features for sonic illumination and lowers the cost and complexity by a considerable amount.

The Underwater Lens

Soneye, being an underwater sound reproduction of the human eye, uses a lens to see with. Again, all mention here of seeing means by the use of sound waves. The only light waves used are between the actual viewer and the pilot's eyes.

A liquid lens is used (see Fig. 1). "Fluorolube," made by the 3M Company, is very useful for this work. It may be enclosed in a thin aluminum sphere which is mounted in "RHO-C," a special type of rubber which matches the acoustical impedance of sea water.

The action of such a lens is similar to that of the human eye or the dielectric lenses used in microwaves. Such action is detailed in Fig. 2, where object A is focused on hydrophone A and object B on hydrophone B, etc., until an image is formed. This is the same process your eyes are using to read these words.

Sound waves traveling through the center of the lens are delayed more than those going through a smaller amount of the special liquid, near the edges. It is the same liquid throughout the lens. This action causes the waves from any single point sound source to be focused at a single detector, or hydrophone.

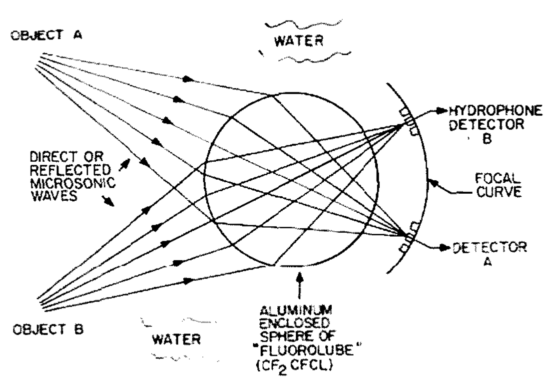


Fig. 2. Sonic lens action for illumination substitute sonic radiators for detectors.

Power gains of 30 dB and over (one thousand times in power) and sharp beams are obtained by such lenses, as shown in Fig. 3, which details patterns and gains from actual tests underwater.

When a "sound wave retina" of small hydrophones is placed on the focal surface at the rear of the lens, as in Fig. 1, a sound wave image of the scene out front is produced, when such scene is illuminated by sound waves from one or more of the sources detailed earlier.

Note that the placing of the hydrophones on the focal surface is under the control of the designer, and thus no lens corrections are needed.

The maximum angle of view, that is, how much of a scene out front can be viewed without turning the whole lens (or any part of it, and without any sort of phasing or scanning of any kind) is a solid angle or cone of 90°. Thus six lenses can take care of the entire sphere surrounding a submarine.

In all Soneye systems so far, the illuminating lenses are always separate from the viewing lens.

The size of the lens may vary from a pair of 1 in. liquid spheres in a stereo underwater seeing headset system for a scuba-diver, to a very large one, like 10 or 20 ft in diameter, for use on a large and fast submarine.

The Microsoundwave Viewing System

Fig. 1 shows the major features of the viewing portion of the Soneye system. The lens action described earlier details how the reflected microsoundwave energy arrives at each individual hydrophone. In the mosaic of hydrophones (retina) placed at the rear of the lens, each unit is positioned at the best focal point while operating underwater.

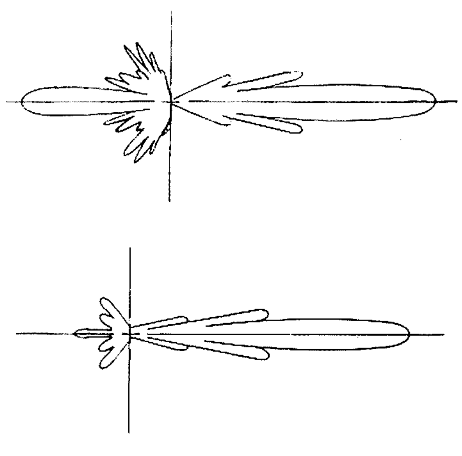


Fig. 3. Beaming effect of Soneye. Actual gain patterns.

Each hydrophone is followed by an amplifier operating at the microsoundwave frequency. At these frequencies, which may be from 5 kHz up to 1 MHz, according to distance and/or picture and using needs, it is mainly a matter of low noise stage first, followed by gain stages suitably arranged for dynamic range, demodulators, modulation frequency filter-amplifiers, and more demodulators. In general, the modulating frequency may be quite low, the bandwidth needed not exceeding 24 Hz for normal operator viewing.

Fascinating possibilities are opening today for enclosing very large numbers of very small amplifiers in small containers. Among components advancing rapidly in this direction are Microtabs, microcoils, and IC's. Some very fascinating little transistors are made by G.E. under the name Microtabs which are really small, less than .060 in. thick. They work just the same as their big brothers and do nicely up to 1000 MHz.

The Piconics Co., North Billerica, Mass., make signal amplifier coils which are a good match for the Microtabs in size, a tuneable core unit also being less than .060 in. thick. Along with tenth-watt resistors and "Slim-cap" capacitors, I have homebrewed good working printed circuit amplifiers the size of postage stamps with a total overall thickness less than 1/10 in. Using these kinds of discrete components a skilled amateur homebrewer can make complete amplifiers between ¼ and 1 in. cubic volume.

Integrated circuits and Large Scale Integration present even greater possibilities, although the manufacturers of these devices still shy away from claims of flat packs with 200 to 300 transistors for use with *tuned circuits*! However, there are possibilities even today of making up quite small units. Good flat packs, ¼ in. long, 1/8 in. wide, and 1/20 in. thick and real

small coils (they still cost dollars in small quantity) can be made up into amplifiers in the near future with some 100 to the cubic inch. A camera case size box then begins to carry quite a number of picture elements, like perhaps ten thousand, capable of a 100 line picture.

The Viewer

The basic component of this device at the moment is the "microlight," one for every hydrophone-amplifier chain, arranged in a mosaic viewer as in Fig. 1. I have some of these tiny bulbs operating here, and they are only .012 in. (12 mils) thick. Leaving a little room for cement or other, you could put 50 lines of 50 in each line for a total of 2500 picture elements in a square inch, thus making practical today the 2D stero-viewer-headset. Fig. 4 shows how basic a good light bulb amplifier can get.

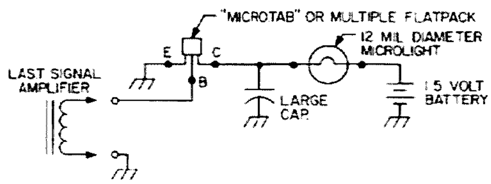


Fig. 4. Basic light amplifier circuit.

Also, nothing prevents a forward looking bulb manufacturer from putting several thousand filaments in one evacuated bulb!

This might be an excellent application for the newly developed light emitting diodes (LEM's), which are tiny enough to be considered for near-future television screens. Different color diodes could be used to indicate depth in viewing with blue for most distant objects, green for nearby and red for close. The diver or operator would soon get used to a system such as this and "see" underwater automatically. Diodes would have the virtue of using far less power than even the tiniest of filament lights.

By proper handling of the control characteristics of the signal frequency and modulation amplifiers, a large dynamic range can be achieved with this circuit.

A 3D viewer can also be made quite small. Many forms of this type of viewer are of course possible, including the beam-splitter type which projects the viewed scene onto a semi-transparent glass in front of the pilot's eyes. This allows the light waves from the actual scene out front to be used by his eyes, when and if a visual image does break through the water ahead, presumably at some short distance.

Note thc fail-safe feature of having many separate complete receivers. 10% can be out of order, and the main scene will still be present for the pilot.

Fiber-optics are also well suited to bring this type of image to places other than where the light bulb viewer actually is.

2D Ranging

The simplified version of Soneye, like the human eye, uses only two dimensions, elevation and azimuth, to use military type terms. Range, or depth perception, is supplied by a host of optical and mental tricks, among which may be cited stereo, decreasing size with increasing distance, foreknowledge of the size of the object, displacement against a background or other stationery scenes, ability of the human eyes to point together at a given distance, and other methods.

The 2D stereo Soneye is arranged to employ most of these factors and is considered to have some 80 to 90 percent of the ability of the human eye for the purpose of depth perception. This percentage figure is of course dependent on the number of picture elements used, which becomes mainly a matter of cost.

Enhanced depth perception is easy with Soneye, the two lenses have only to be separated by a distance greater than the average 2¾ in. between human eyes. This is already done in certain aircraft cameras looking at the ground, where a one story building can be made to stand up like a four story one.

It is hoped that my ideas on the Soneye will start some neurones oscillating, steaming up the synapses with visions of light emitting diode matrixes and the millions of dollars to be made therefrom. Please don't forget to send an old man a little royalty check now and then from the profits. Okay?

. . .K1CLL■

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RF Power Measurement with Hot Carrier Diodes

Two rf wattmeters are shown here, one with a range of 25 mW to 10W and the other covering the range of 5 to 300W. Both are useful from low radio frequencies on up through 450 MHz.

The low-power version (Fig. 1) makes use of a 20W Sierra dummy antenna built into the meter case, though the metering circuit only goes up to 10W. If the maximum is to be 20W, the reference meter reading could be about 45 μA instead of 30. The minimum power reading would be doubled. In this wattmeter, the power range potentiometer is calibrated and only a reference line on the meter is used when making rf measurements. The dummy 50Ω antenna resistor is rated up to 1000 MHz so is excellent from 450 MHz down.

The range potentiometer had an audio (nonlinear) taper. By connecting the "high" resistance end to the diode, the watt range scale is spread out quite well in the 0.1 - 10W range. The hot carrier diode, an HP 2900, has a 10 PIV rating, which means that the rms rf voltage across it should be less than 3V for safe operation. At 10W of rf power, the rms voltage would be a little over 22V, which means a voltage divider is needed to keep the applied diode voltage down to about 2V. An HP 2800 diode with a 75 PIV rating would be more desirable, especially if the meter was to be calibrated for 20W maximum. This diode is about $1 and has a little higher capacitance, which would require a different shunt capacitance across parts of the resistor divider to make the device work with the same power range calibration.

The divider should use ½W resistors of the carbon or metal film type, since these units are part of the rf circuit. It is better to use three ½W 300Ω resistors in the string rather than a single 900Ω 2W resistor; this is because the rf resistance characteristic is usually better in ¼ or ½W types in certain ranges of resistance. Every resistor has some inductance and shunt capacitance which becomes part of the voltage divider. The diode shunt capacitance is in parallel with that of the 110Ω ¼W resistor in Fig. 1. However, nearly any combination of resistor sizes can be equalized within 10 to 20% over the desired frequency range. This divider is across the 50Ω dummy antenna, so should not shunt the value down to less than 49 or 48Ω. This divider

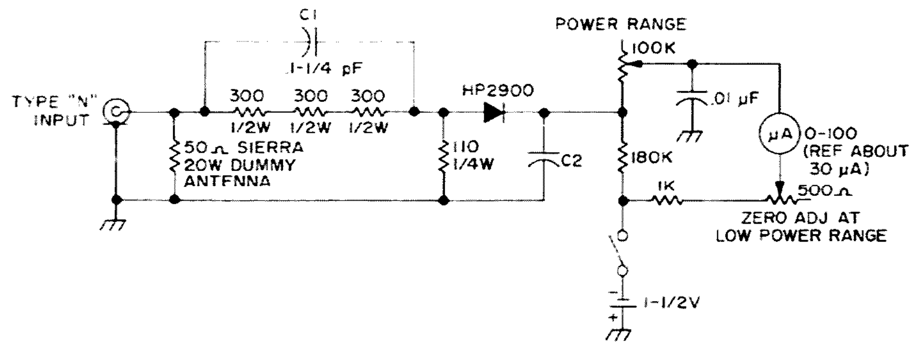
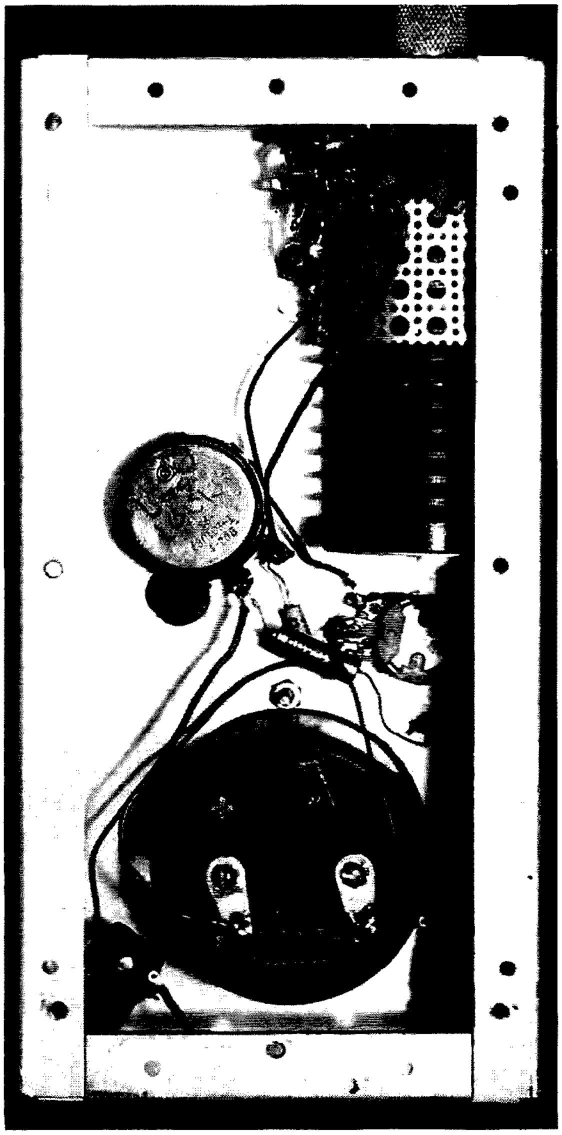


Fig. 1. .025 to 10W RF wattmeter.



Bottom view of 10W unit with the rf dummy antenna clamped in one corner.

Top view of low powered rf wattmeter covering .025 to 10W. Built into a 8x4x2 chassis with wire screen bottom plate for ventilation.

has to dissipate a little rf power also. Its total resistance should be at least 20 times as high as the dummy antenna load resistor.

The values shown in Fig. 1 are just about the minimum that should be used. Too high values makes it more difficult to extend the frequency range to the upper end, though it can be done, as was discovered in the higher-powered wattmeter of Fig. 2.

All diodes are poor rectifiers at applied rf voltages below their forward bias values of 300–700 mV (peak). By using a forward dc bias voltage to make the diode conduct at least 5 or 10 mA, the detection sensitivity is increased as much as 5 or 10 times. This requires a small battery, a couple of fixed-value resistors, and an adjustable pot to balance this current out of the meter when measuring rf powers below 100 mV. If the power range is limited to a minimum of ¼ or ½W , no bias circuit is needed in this 10W instrument. The range scale in either case has to be hand calibrated.

A low-powered radio transmitter or exciter can be used as a 10W power source when calibrating the power range pot scale. The transmitter can use stage detuning to reduce power outputs down to the lower values needed. Many swr meters have watts of power calibration and one of these can be put in the coax line to the rf wattmeter for calibration service. A more accurate

calibration can be made by comparing the power readings against some reliable commercial rf wattmeter within its frequency range and calibration charts. This scheme is usually necessary for checking the calibration at VHF or UHF. Another method is to use an accurate rf voltmeter across the dummy antenna connection to ground and read the power values in watts = E^2/R. For example, 5V (rms) squared is 25; and divided by 50Ω is equal to 500 mW.

The Sierra 50Ω dummy antenna has no connection available at the high end of the resistor, which terminates in a type N fitting. The metering circuit has to connect to this point as close as possible by getting into the inner conductor of a coax fitting, or by drilling a 3/8 or ½ in. hole through the shell of the dummy antenna close to the rf fitting end. This can be done and the first 300Ω resistor in the voltage divider soldered to the inner connection to the large 50Ω resistor. A long 1/8 in. diameter soldering iron tip is needed. The divider resistors, diode, and four .001 μF stud-mounted bypass capacitors were all mounted around this large hole in tapped 6-32 holes for the four capacitors. Larger values of bypass capacitors can be shunted across these 0.001 μF values to ground to extend the frequency range down to low rf or even af values. For example, a .02 μF capacitor shunt would allow operation to 2 MHz. A miniature 50 or 100 μF electrolytic shunt would function at audio frequencies down to 300 Hz. The diode must have a low-impedance path to ground over the desired frequency range to function as a peak rectifier and get as much dc output voltage as possible for the meter circuit. The microammeter in series with a variable range resistor is simply a dc voltmeter. The diode rectifier converts rf voltage to dc, so the diode should be equally efficient over the whole rf range.

The 5–300W unit was built to use with a large dummy antenna rated up to 500 MHz, which is a massive unit external to the box shown in the photographs. Quite a bit of rebuilding went into this device to make one calibration of the range potentiometer fit all frequencies from 450 to 2 MHz. The input and output coax fittings had to be finally mounted so the inner conductor tips could be soldered together and the resistor divider connected to this point. The latter consisted of two 4300Ω 2W carbon resistors and a 68Ω 1W resistor in series to a copper sheet inside of the aluminum box.

The watt range variable resistor was a 500 kΩ linear potentiometer which was limited to a lower value by shunting it from the moving arm to the diode connection end with a 220 kΩ resistor. This gave a maximum power reading of 300W when the reference line was drawn on the meter face at 12 μA. The import, low priced, 0–30 μA meter had a large meter scale. A smaller 0–50 μA meter would have been usable, since the meter is used only as a reference. The range pot knob is adjusted when rf power is applied to run the meter reading up to the line drawn on the meter scale face.

The circuit shown in Fig. 2 was equalized to within about 15% error over the range of 2 to 450 MHz by shunting a 5 pF capacitor across the 68Ω resistor in the rf divider.

Calibration of this device was made at 144 MHz using a transmitter having up to

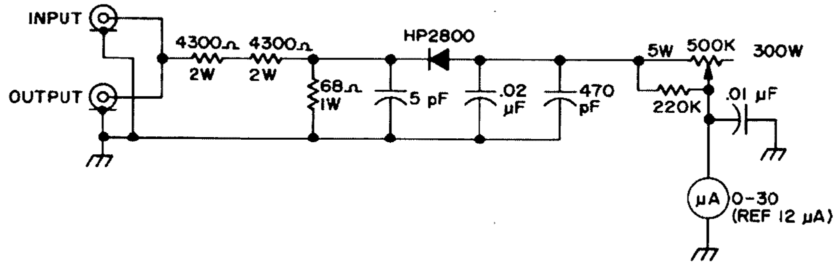
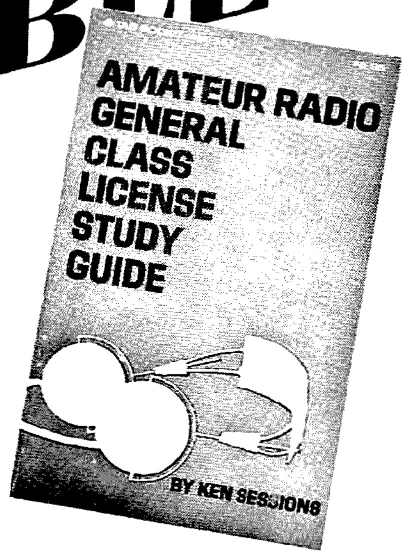


Fig. 2. 5 to 300W RF wattmeter metering circuit. External 300 or 400W during antenna load.

IMPOSSIBLE?

No! Just Difficult.



It is not impossible to pass the General (or Technician) Class amateur license exam if you haven't read this superb license study course. Dozens of amateurs have managed, though some have had to make several $9 stabs at it to get by. Now, being realistic, isn't it only practical to invest a lousy $5.95 in this incredible book to make sure you don't blow that $9 bet (plus all the inconvenience, expense, nervous frustration and embarrassment of failure) that you can pass the first time around?

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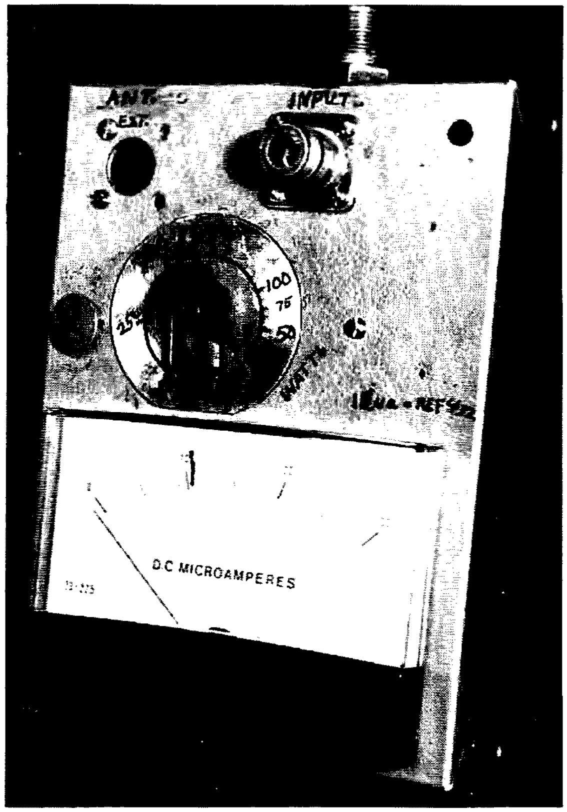

Top view of 5 to 300W metering circuit for use with external high powered dummy antenna.

400W available carrier output. The meterizing unit was connected to a large Bird rf wattmeter at the external fittings of the latter. Several thermocouples had to be used to cover the wide range of power for the calibration. This required reading a chart curve for each Bird wattmeter reading and using correction factors for frequency in order to obtain the actual watts of rf power. Now, the large unit is used without the thermocouples, charts, rf choke, etc. simply as a dummy antenna. The new metering circuit connects directly into the antenna fitting, with a few feet of 50Ω coax over to the transmitters being tested.

This power measuring device can be used in any 50Ω coaxial line to monitor the actual power going toward the antenna. The swr in the line should be low, or near unity, in order for the calibration to be reasonably accurate.

W6AJF

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IC/Photocell Compressor/AGC Unit

The unit described can be used as an audio compressor in a transmitter or as an audio agc unit in a receiver. The use of a photocell allows particularly easy adaptation of the unit to an existing piece of equipment.

One problem with many compressors or audio agc units is that they cannot be conveniently built into an existing transmitter or receiver, since the amplifier and control sections of the unit cannot be readily separated. Consequently, such units are usually placed in separate enclosures and mounted in the microphone lead to a transmitter or in the loudspeaker or headset audio output leads of a receiver.

Most such conventional compressor/audio agc circuits use transistor stages for both amplification and control functions. It is difficult to separate the stages physically unless additional coupling stages are added, so that the amplifying and control functions can each be located where each can function best and where power and space in a transmitter or receiver are most readily available (see Fig. 1A).

The IC/photocell unit to be described overcomes most of these limitations. The amplifying and control functions can be separated as desired (Fig. 1B) through the isolation medium of a photocell-lamp module. Although described as an audio compressor/agc unit, the photocell-lamp module allows control to be achieved of an rf stage as well through its biasing network. Only the derivation of the control function is restricted to an audio frequency point in a receiver or transmitter, since the IC amplifier used operates at audio frequencies. In an rf amplifier, an rf actuated and rf control compressor could be achieved. Although it has not yet been tried, it would seem that this latter approach might produce a highly effective SSB rf level compressor without the need for two sideband filters as is required with

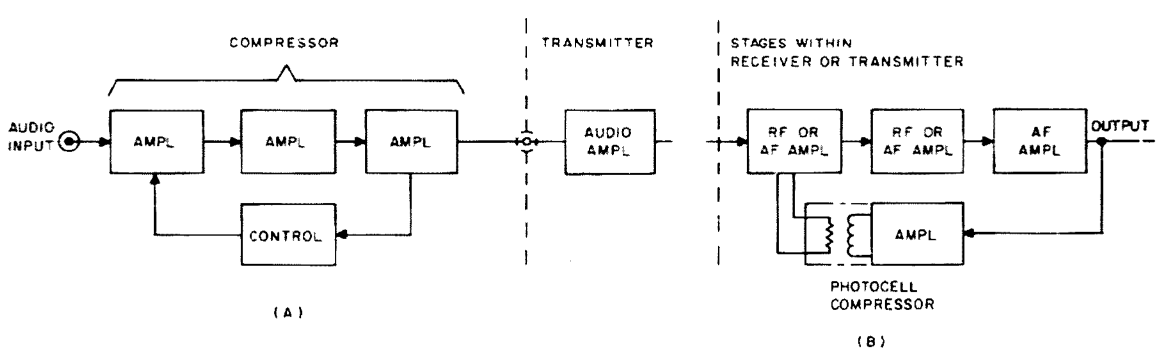


Fig. 1. Amplifier stages of usual compressor are in series with transmitter or audio chain (A). Photocell compressor (B) works parallel to controlled stages and the photocell module provides both noise isolation from compressor amplifier and feedback isolation between controlled amplifier stages.

SSB rf level dipping circuits.

Besides separation of the amplifying and control stages, the use of a photocell-lamp module also overcomes the noise build-up problem associated with conventional audio compressors. With such compressors, noise build-up occurs at the output of the compressor during speech pauses because, without speech input, the gain of the compressor rises to a high value and amplifies the self-noise of the first stage in the compressor to a high value. Choosing a long time constant in the gain control stage of the compressor will act to suppress such noise build-up, but one is quickly limited as to how far this approach can be used. If the time constant is made too long, low level speech inputs to the compressor following a higher intensity input will not be amplified sufficiently. Since the amplifier stages of the photocell compressor need not be in series with the audio chain in a receiver or transmitter, its noise output is not reflected in the controlled stages. Also, the thermal-photoelectric interface within the photocell-lamp module prevents the coupling of noise or spurious frequencies from the audio amplifier of the compressor. In fact, the audio amplifier portion of the photocell compressor can be rather simple and produce considerable distortion without affecting the units' performance. The only real requirement is that it produce a power output sufficient to drive the photocell module which is directly proportional to the audio level at the sampling point within a receiver or transmitter.

The use of a photocell also provides feedback isolation between the sampling point and the controlled point in a receiver or transmitter. Since no direct electrical connection is involved between the two points (except for the minor capacitance between the lamp and photocell in the module), one does not have to worry that the feedback loop has a time constant greater than the lowest frequency at which the gain of the controlled stages is greater than unity – a criterion for stability in an electrically coupled compressor feedback loop.

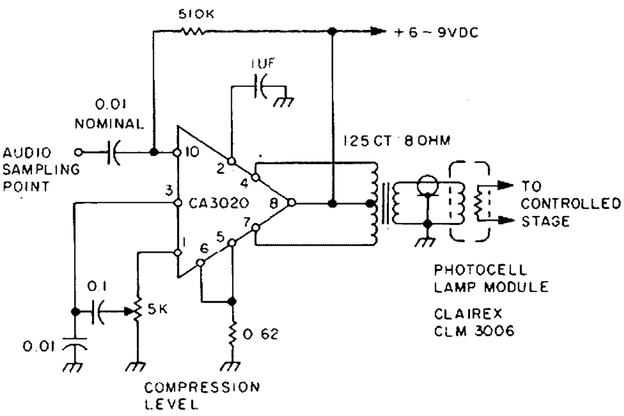


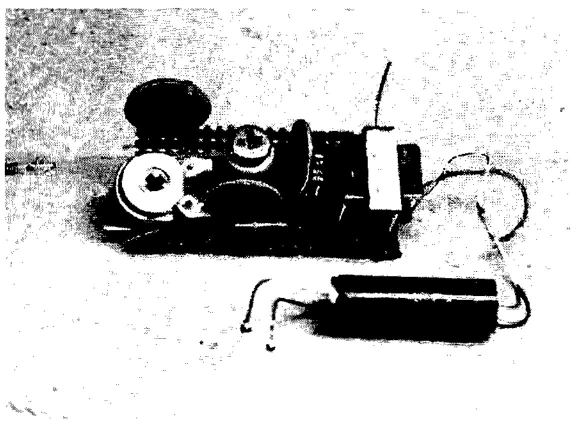
Fig. 2. Photocell compressor/agc circuit schematic. Voltage rating of capacitor to terminal 10 must be chosen to protect unit from voltage found at sampling point. DC operating voltage need not be supplied from an extremely well filtered source since audio quality of amplifier is not significant.

Circuit Description

Figure 2 shows the schematic diagram of the compressor/agc unit. The integrated circuit used is an RCA CA3020 which can produce about 500 mW output. Various other audio amplifier integrated circuits can be used such as the GE PA234 and also various surplus operational amplifiers can be used. A module type audio amplifier or discrete stage transistor amplifier can also be used. The prime criterion is that the amplifier produce enough power output to properly drive the photocell – from 150 to 250 mW.

The external components used with the IC are chosen primarily to give sufficient power output rather than maximum undistorted power output, as would be the case if the IC were used for strictly audio reproduction. A 5 kΩ potentiometer between stages in the IC acts as a compressor level control. No input potentiometer is used due to the fact that even if some slight overdrive of the input should occur, it would not be significant in this application. The output transformer secondary drives the lamp of the photocell module. The module may be placed any reasonable distance from the amplifier and connected to it by shielded audio cable. It is not necessary to rectify the output of the

amplifier, since the thermal inertia of the lamp in the photocell module will "wash out" instantaneous level variations. The photocell module itself can be any one of a number of Clairex or General Electric units which sell for $3–$4. The Clairex CLM3006 unit works well for a general variety of applications. Its lamp drive



Assembly of compressor/agc units on Vectorboard. Photocell unit is shown next to output transformer. Compressor level pot is at other end of Vectorboard, and IC unit is in middle with circuit components grouped around it.

requirements are 6 volts at 40 mA maximum, and the resistive element in it will vary from a value of over 100 kΩ when the lamp is not excited to about 200Ω when the lamp is fully driven. The photocell module itself also provides a sort of automatic delay action, since the change in resistance is not linear with lamp drive but generally is slower at low lamp drive levels. Thus, depending upon how the resistive element is placed in a circuit, compression action increases with higher signal levels.

Construction

The photograph shows how a typical photocell audio amplifier driver circuit can be assembled on a piece of Vectorboard. The photocell module would, of course, be located remotely from the amplifier circuit. A fin-type heat dissipation device should be used on the IC, depending upon the manufacturer's recommendation for the unit used. A PC board type trim potentiometer, located to the right of the IC, acts as the compression level control. Since the control does not have to be readjusted normally after initial setup, it can be left as a component on the Vectorboard. If it is desired to have some means to continuously control the compression level as well as turn off the compression action, the potentiometer – brought out as a panel control – will perform both functions. The output transformer on the left is a conventional miniature transistor type with an 8–16Ω secondary.

Placement

The objective in placing the resistive element of the photocell module in a receiver or transmitter circuit is to make maximum use of its wide resistance change. At the same time, the resistive element cannot be used such that it must dissipate over 1/10 watt. One possible placement for the resistive element is shown in Fig. 3A, where it is used as part of a voltage divider network in a fairly high impedance circuit. In some units the microphone input itself or the interstage coupling point after the first audio amplifier might be used. Theoretically, the large resistance range change of the photocell resistive unit could produce voltage output changes in a high impedance divider network of over 40 dB. Another possible placement of the resistive element which also prevents dc from flowing through it is shown in Fig. 3B. As the photocell module is driven harder, the resistive element increasingly shorts to ground the audio bypass capacitor. Such a capacitor would be placed between audio stages in a receiver or transmitter to shunt the audio signal to ground as compressor action takes place. There are various other placements possible for the resistive element, such as in the bias line to the stages it is desired to control or even as a shunt element across a low level audio transformer. The placement that will achieve the best control can be quickly determined by experiment.

The sampling point for the compressor's audio amplifier input is usually taken at some interstage point towards the high level end of the audio chain in a unit. The sampling connection should have no effect

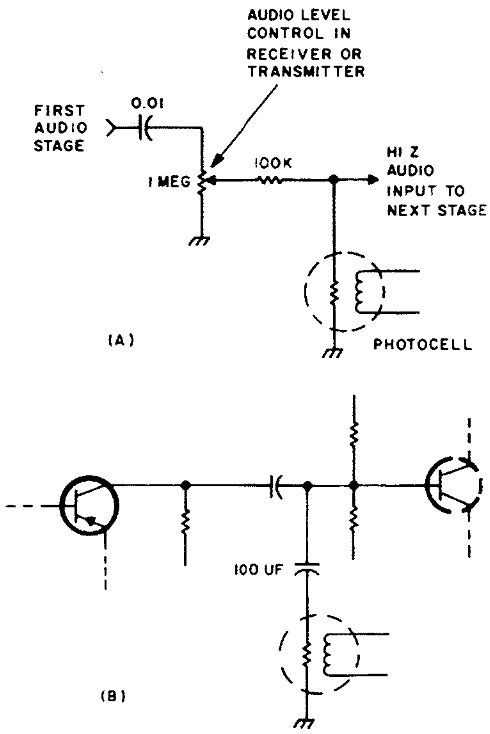


Fig. 3. Possibilities for using the resistive section of the photocell for control of the signal amplitude in an audio amplifier. Voltage divider method (A) and capacitance bypass method (B).

upon the normal operation of the audio amplifier in a unit. If possible, the sampling point should be chosen such that the audio level control in a unit is located earlier in the audio chain. The controlled point can be either before or after the audio level control.

Operation

With the compressor control initially set for minimum gain, the audio level control in a unit is set for the highest desired audio level. The compressor control is then advanced until the audio level decreases significantly. The audio level control is again advanced until the desired output level is achieved. Basically, the circuit should then be set, although one will have to initially adjust back and forth between the audio level and compressor controls until the optimum compression range is obtained.

Summary

The photocell module is a very versatile unit for compressor and agc control circuits. Many more circuits are possible with it than the one illustrated here. For instance, if one wanted to use a varying dc voltage as the control source for the module this can be done by using a dc amplifier and direct output coupling in place of the audio IC amplifier shown. With some low power vacuum tube circuits it is also possible to place the lamp of the photocell module in series with a cathode resistor and achieve direct control without any amplifier at all.

. . .W2EEY■

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The Theft Stopper

Ever wished for a way to prevent your mobile rig from being stolen? You've seen the many car alarm devices on the market today; but for the most part, all they do is blow the horn . . . too bad if you're out of earshot! Even if you do catch the thief with your goods, you have to apprehend him . . . probably with your bare hands. Then you run the risk of a crowbar across the head, or if the thief has a knife, well . . .

About 99.9% of us are not karate or judo experts and we'd run the risk of personal injury to ourselves.

So along comes a product on the consumer market called On-Guard(tm), a self-defense invention in a tube. At first glance, it looks like a felt marker pen, being about 3½ in. long and ½ in. in diameter. It's filled with a chemical which is absolutely harmless (not Mace or tear-gas) but, however, causes the following temporary effects: stinging and burning of the nose, throat and eyes; nausea; after burning the throat, it produces choking and coughing, and gives the recipient a weak-in-the-knees feeling. I can certify the effects, as I took a small whiff of the stuff! (My last, by the way!)

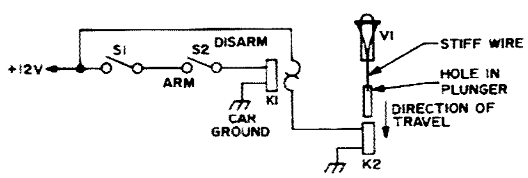

Fig. 1. Schematic of theftstopper. S1 is your car's courtesy light switch; S2 is a toggle; K1 is a delay relay (10 sec.); K2 = 12V solenoid, heavy-duty; V1 = On-Guard chemical spray tube.

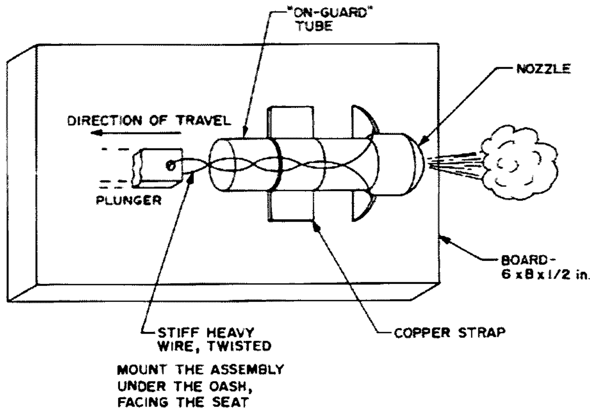

Fig. 2. Detail of solenoid plunger and tube.

One whiff of the mist and your nose tells you to go the opposite way . . . fast! Stealing a transceiver, microphone, or anything in the car will be the farthest thing in the thief's mind. The chemical vapor will stay in your car a long time.

To make the automatic theft stopper, you need a 10-second delay relay (12V), a 12V heavy-duty solenoid, a single-pole toggle switch, an On-Guard, and a 6x8x½ in. board. A sample circuit is shown below. The On-Guard can be bought for $2.98 each, postpaid. On-Guard cannot be sold to residents of California, New York, Wisconsin, or Michigan. They can be sent by mail to all others, however.

I might add that the U.S. Post Office has made a decision to issue them to all letter carriers, to protect against biting dogs and whatever.

. . .K4EPI■

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A MARKETING MAN'S APPROACH TO HAM RADIO

The growth of ham radio in the last 5–10 years has been anything but encouraging. The numbers tell the story loud and clear: While population, leisure time and disposable income have all increased, ham radio has remained stagnant. Unless we reverse this alarming trend, we will join the dinosaur in Nature's list of species that no longer exist.

Why we have let this situation develop is a question I will leave to the psychiatrists in our ranks to discuss. What can be done about it is something else again. The cure for our lack of growth can be summed up in one word: marketing.

Marketing: that art/science that deals with getting buyers together with products or services. I believe that by using some basic marketing techniques we can greatly increase our growth. The key to this requires some rethinking on our parts. We must stop considering ham radio as a hobby/service. . .and start thinking of it as a product to be sold. And it can be sold. . .it can be packaged, presented, and promoted just like new cars, breakfast cereal, or transceivers. But first we must become accustomed to handling and thinking about ham radio as a product. Some of the basic marketing techniques that will allow us to do this are discussed below.

Buyers & Benefits: For any product to exist for any length of time, someone must be willing to buy it. And buyers do not buy products – *they buy the benefits those products supply*. Think about it. You buy a new car not just for the sake of having a new car, but for the benefits that car will bring. . .improved styling and performance, comments from friends, a feeling of importance or difference at having a new car when others don't. Buyers buy benefits, not products.

Advertising: To have a product full of benefits that people are anxious to buy is common. To have a product like that, and then believe that buyers will flock to your door through divine intervention is stupidity. . .yet that is exactly what we have been guilty of for many years. It is not enough to have a good product. You must tell people that you have it, and tell them

in such a way that the benefits of your particular product become clearly superior to supposedly similar benefits from other products. This is the basic idea of advertising and it is a lesson we must learn if we are to survive. Yet we have acted as if we were actively trying to keep the existence of ham radio a secret. Probably we were not, but we couldn't have done a better job. Few people even know we exist, and those who do tend to dismiss us as a bunch of nuts playing with toys. Not only must we let the world at large know about ham radio and what it can do, but we must do it in a way that will encourage others to join us.

So much for basic marketing. Let's return now to discuss these points in greater detail; first, the benefits, then the buyers who would be interested in these benefits, and lastly the area of advertising.

Benefits.

The benefits of ham radio are myriad, but some of the more obvious are detailed below. Indeed, many of these are common to all successful products.

Ham Radio Is Different. A product which is different has instant appeal. Volkswagens are radically different from their American counterparts in many respects, and these differences have helped make the VW the largest selling imported car in the U.S. It's ugly; its gas mileage legendary; its service network vast and well organized. A list of the Bug's differences would be long, but the assumption to be made is valid: differences help sell products.

Ham radio has these differences in abundance. It is really a one-of-a-kind product. It offers instant communications around the world, across the street. It doesn't depend on weather to be enjoyed, like many sports. It is relatively inexpensive to get into, as opposed to most other types of recreation. And it is the fastest way known to meet new friends and become exposed to wide variety of new ideas. Amateur radio is different from everything else you can think of. These differences are benefits to potential buyers . . .use them!

Ham Radio Is Educational. Today's largest, fastest-growing market is education. People are discovering that to improve their world they must first understand it. . .and they are trying to do just that in record numbers. Classrooms are overflowing 18 hours a day. . .home study courses and books are the hottest thing going . . . long-forgotten arts and crafts have suddenly been rediscovered.

The key to this phenomenon is self-improvement . . . and self-improvement is an FCC-imposed requirement. It is a benefit. We live in an electronic world, and it can only become more so. Remember that when you go out to sell ham radio. It is the only hobby around that not only offers an enjoyable diversion, but an opportunity to better understand our electronic environment.

Ham Radio Has Snob Appeal. While that may be a poor choice of words, it is nonetheless quite true. People buy Cadillacs and Rolls-Royces not because these cars offer much more in the way of basic benefit (transportation), but because this type of vehicle has snob appeal. These cars scream out that their owners have achieved some measure of financial success.

We all desire this sort of recognition . . . we all need to be unique in some way . . . and ham radio offers the chance for uniqueness. It sets us apart from the masses . . . that ticket and rig endow us with an extra measure of respect whenever the other guy is made aware of the situation. Use this benefit in small doses, however. No one likes to be reminded that in some respect he is not as good as you. Snob appeal works for many other products and it can work for us, too.

Ham Radio Is A Challenge. In a world full of pushbutton, computerized conveniences, people still like to tackle something with just their hands and minds, and overcome it. When confronted by an appealing challenge, most people take it up, for they know that successful completion will make them feel quite good.

The challenge in ham radio is obvious. Unlike another radio service which can be entered with an examless application, all the money in the world won't buy you a

don't overlook the kids who would benefit most from an involvement in ham radio. These are the ones in orphanages . . . in the ghettos . . . on probation and in correctional institutions. There are tens of thousands of these kids who've gotten off to a bad start in life. Ham radio could change their attitude toward the world and other people, and make them useful, productive, creative citizens. These kids need ham radio and we need them. Think about it.

Organizing an efficient program to recruit large numbers of kids would be a costly, time-consuming task. Worthwhile, but still beyond the capabilities of most of us. There is an area where we can all help, though – and that is on a one-to-one basis. Just find a kid who might be interested and talk to him about it. When was the last time you invited the kid down the street into your shack? If you haven't tried just this simple gesture, please do. You can't imagine the wonder in a kid's eyes when he discovers that he can actually talk to someone in another country. Try it . . . you'll be amazed at the results you can get with just a friendly invitation and a short QSO.

The first major group mentioned above – those already interested in communications or electronics – are the second major group containing potential hams.

CBers come to mind immediately, and it's a giant-sized market that we've done little but aggravate. Most CBers are, believe it or not, real human beings, and they respond to the same kind of treatment you and I like: friendliness, courtesy, etc. Attend your local CB club's meetings, get to know the members. Many of them are just frustrated hams who have been turned off by a past failure or the continuing war of CB vs ham radio – a war kept alive by a few idiots on both sides. Give the CBers an honest try . . . you may be surprised at the favorable response you get.

In this same category fall the experimenters and hobbyists . . . the high school kids just beginning to fool around with electronics . . . the guys who build Heathkits. Both types are prospects. If you know

ham ticket. It takes study and determination . . . you have to earn it. Explain the challenge in ham radio to your prospective customer without making it sound so complex that he loses interest. Confront him with the challenge head-on . . . and watch it work.

The Market

So much for some of the benefits of ham radio. Let's turn now to finding our market.

Most people, whether they realize it or not, could derive some benefit or satisfaction from becoming a ham. Granting this to be true, the question of finding the market then resolves down to one of locating groups where we would be most likely to recruit the greatest number of hams at the lowest cost in time and money.

The two groups that we should be aiming at are those that already have an interest in some form of electronics, and people who have a natural curiosity about the world around them. Let's take the second group first.

Children. Natural curiosity. The two are practically synonymous. Kids are the most important, most readily accessible single group of potential buyers we have, and they've been studiously ignored for far too long. Kids are the future of ham radio and we should concentrate our efforts on them.

Younger grammar school children are probably too young to get really involved, but that shouldn't preclude at least letting them know that we exist. An impression made on a seven- or eight-year-old now will eventually bear fruit in the form of a green but enthusiastic Novice five to ten years hence.

High school and older grammar school kids are in the market right now . . . we don't have to wait to see if our sales pitch pays off. Get permission to demonstrate your rig in school assemblies . . . invite the paper boy in to see the shack . . . ask the neighbor kids if they'd like to talk to someone across the country, around the world. Volunteer your services as a radio merit badge counselor for your local boy scout troop. The possibilities are endless.

Most groups of kids are obvious, but

any, invite them to your shack or club meeting.

So far we have touched on benefits and buyers. The last area, one that I am particularly familiar with, is advertising. With the sole exception of their recent movie effort (which is quite good), our national organization has done nothing to promote the growth of ham radio, so it must be done by us, as clubs and individuals. If you would like to see ARRL do the job, I suggest that if they were suddenly deluged by 100,000 or so QSL cards requesting them to embark on a national ad campaign, they could do little but start one. Lacking a national campaign as we do, however, we must concentrate on things that can work for us on a local level. Here are just a few ideas that have worked for me or for clubs. Most are merely attention-getters. The balance of the selling process is up to you; but once you have the interest, the final sale should be relatively easy.

Call Letter Plates. Maybe you never considered your call plates as advertising, but they most definitely are. They tell everyone that you are someone special . . . and they generate questions. They are available in most states upon proof of license, and although they may cost a slight amount more, in many states they allow you to license your car by mail, instead of having to stand in endless lines. That alone is enough to prove their worth to me. If you've never tried call plates, check into them.

Conspicuous Stations. Under this heading I would lump everything from 200 ft orange towers to complete stations set up in the living room. Let your imagination run wild. Put your call letters on your mailbox, your business cards, and personal stationery. Post your DXCC, WAS awards, and QSL cards over the dining room table . . .leave your Heathkit assembly manuals on the same table with Time, Life, and National Geographic. Put copies of 73 in the bathroom, where you have a captive audience. Make lamps out of old vacuum variables and finals that have gone to their reward. Pick your teeth with a resistor lead . . .light your cigarette with a hot soldering iron. . .carry an FM pocket transceiver around with you. Do something that will cause questions.

Portable Operation. For those of you who are camping, hunting, or fishing nuts and have a sympathetic spouse, it is unforgivable if you don't take along a rig on your outings. When I go camping with my family on weekends, the first items to be added to the camper are an HP-23 supply and a portable 20m dipole. When I set up my station in a campsite, I never fail to draw a crowd . . . which of course is exactly what I want to do. How many new hams have I generated? I don't know, but at the very least there are a few hundred more people out there who know we exist. Portable operation is a form of advertising that is both easy and fun . . . try it.

Group Demonstrations. You would probably be amazed to learn how desperate most schools are to find good, educational programs for assemblies. Check in with your local school system to see if they can use you and your rig; the odds are that they can. Other groups might like you, too: public service groups like the Lions or C of C, Boy Scouts, church groups, ladies garden clubs. Any group is fair game. You'll be surprised at how many invitations you and your rig will get to perform . . . and spread the word about ham radio.

Public Service Work. In many areas hams provide emergency and public service communications, crowd-control assistance, etc. – and never bother to capitalize on their efforts. Incredible! The very minimum you should have is large signs for your tables and cars, proclaiming who you are and what you're doing. If your club does *anything* in the way of public service, you are missing some giant-sized chunks of free publicity.

Publicity. If your club doesn't have a publicity chairman, it should. One good man in this position can contribute more toward increasing your membership than the rest of the club combined. Most hometown newspapers are only too happy to run news releases detailing some sort of public service work, for free. *Any time* your club has a function, whether just

another monthly meeting or a major event involving the safety of other people, get it to the newspapers. The form doesn't matter – it's content that counts. The city-desk man is going to rewrite it anyway. If your club does anything . . . if one of your members in his capacity as a ham does anything, get it to the newspapers.

Radio and TV time can be had too. Many stations have hams on the staff, and a more sympathetic contact would be hard to find. Talk to them . . . find out what they consider to be newsworthy. Some stations will run free announcements about code and thoery classes about to start, participation at local events, etc.

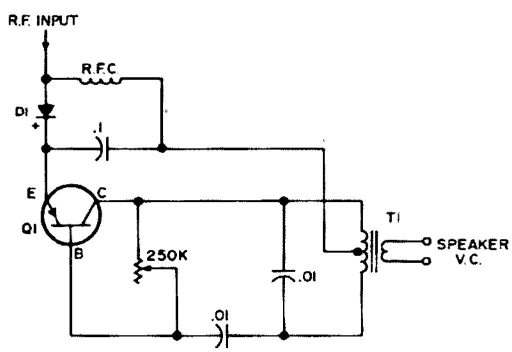
Field Day. Does FD bring to mind visions of a half-drunk group of nuts running around putting things up in the air and shouting unintelligible remarks into a PTT mike? Granted, most field days are run for the gratification of the members involved . . . but don't you think we could find time to include interested visitors in our plans? Sure, it might mean we'd have to stay somewhat sober, bury our Marine Corps vernacular and at least appear quasi-human. But think of the potential! A field day put on primarily to introduce strangers to the world of ham radio might not be a smashing success in the "points earned" category, but it would certainly be one in the final tally of membership figures.

Code & Theory Classes. Any club or group running these classes should make sure that they have an ample amount of publicity to back them up. Tell the papers . . . tell the local radio & TV stations . . . post notices in the schools, laundromats, pizza shops – anywhere that people gather. You'll be amazed at the response you'll get . . . and the new Novices.

In this article I've tried to show how basic marketing techniques can successfully be applied to ham radio, with the purpose of bringing in the new members we so desperately need. The alternative to not promoting our hobby/service is not pleasant. We need new members badly, and treating ham radio like any other product in the marketplace is the only way to get them.

...WB8CDU■

Yet Another Code Monitor



The code monitors in the February 1967 73 must have been a simple answer to many CW men with a monitoring problem. Here's a monitor which works with *any* transmitter, regardless of how it is keyed. All the parts, except the 250k pot, can be found in an old transistor radio and *any* good PNP transistor will work okay. If you have an NPN transistor, just reverse the diode.

As the resistance of the pot is reduced, the note gets higher, and at minimum resistance the monitor is turned off. The simplest way to get *rf* to run the monitor is to connect it to the chassis of the receiver or transmitter; there seems to be enough *rf* floating on "grounded" equipment to run 3 or 4 volts into the monitor in several stations in which this unit has been tried. The volume is loud enough for most shacks and the pitch can be set to suit the operator. The note is by no means a sine wave, but it is pleasant and distinctive. Try it with your transceiver, and break the SSB habit!

John Smith, VK3IQ

Multi-Cha[illegible] Operation with the MOTOROLA HT-200

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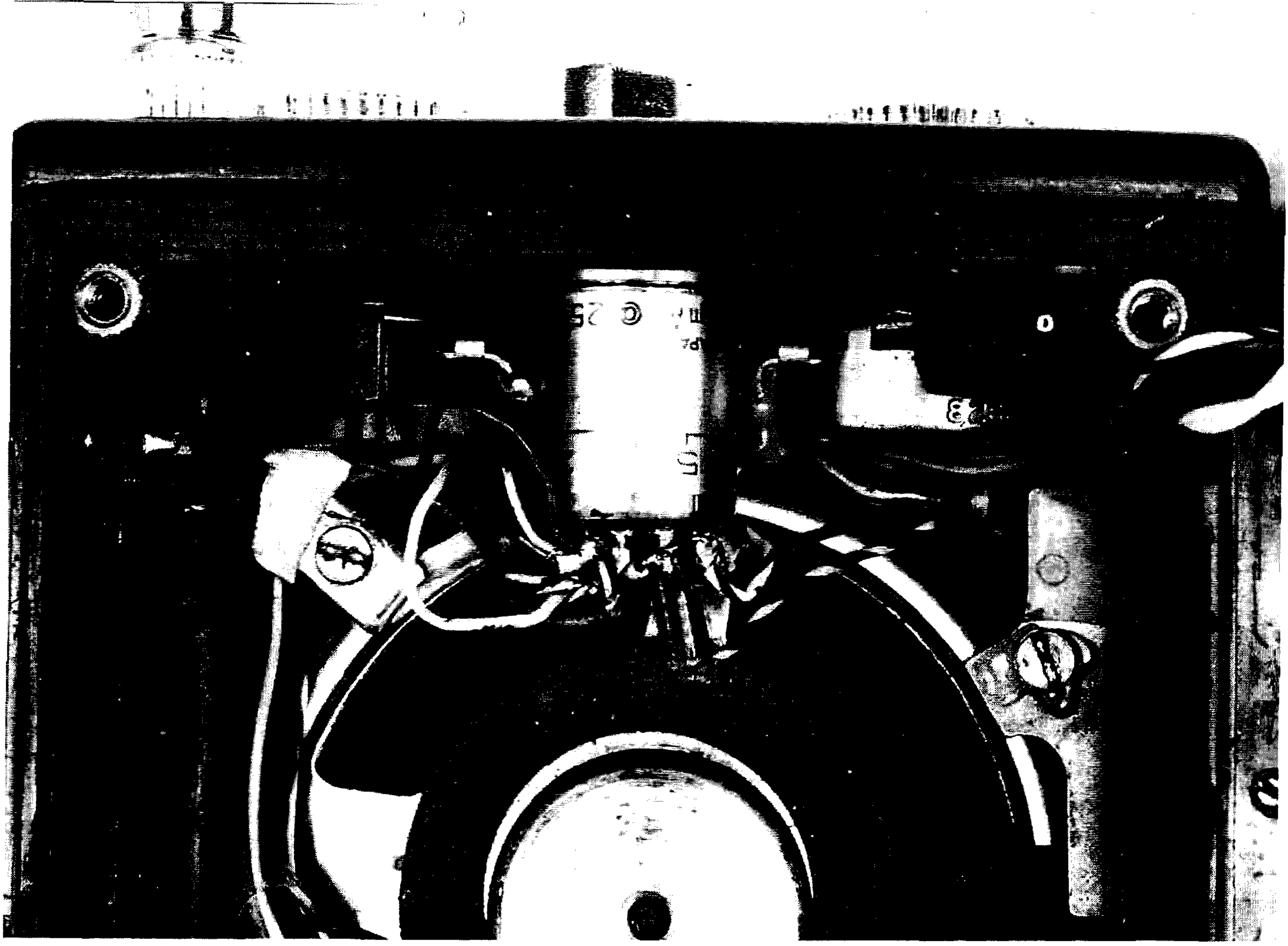
If you are as fascinated with the possibilities of operating the 2m FM bands with hand-held portable gear as I am, you probably have more than a passing familiarity with the Motorola HT-200 (the "brick," as it is known in some circles).

Until recently, this piece of gear has been difficult to pick up on the surplus market. Lately, however, Motorola has released the HT-220, a shirt-pocket unit with approximately the same specifications as the larger HT-200, and many of the "bricks" are beginning to show up on the amateur market at rather reasonable prices.

The Miami Valley FM Association, our local repeater group, recently managed to pick up a fairly large quantity of these units. Unfortunately, however, almost all were single-channel radios. Since our operation utilizes a .34 to .76 repeater, as well as a .94 simplex channel, a dual-channeling program was immediately in order. In addition, a system for providing simultaneous monitoring of both channels was also provided.

This article was prepared to describe the relatively simple process for installing the Motorola second channel transmitter and receiver oscillator decks, as well as describing the switching arrangement which makes simultaneous monitoring of the two receive frequencies possible.

To begin, beg, borrow or steal a Motorola manual for the HT-200. The Motorola manual part number is 68P81058A40-B. It will set you back about $2.50, if you have



Channel switching assembly shown in relation to the interior of the HT case. Although the potting compound has been left off the switch terminals here for the purposes of illustration, it is strongly recommended that epoxy or RTV compound be used for insulation due to the very tight clearances. Diodes are attached directly to the back of the switch.

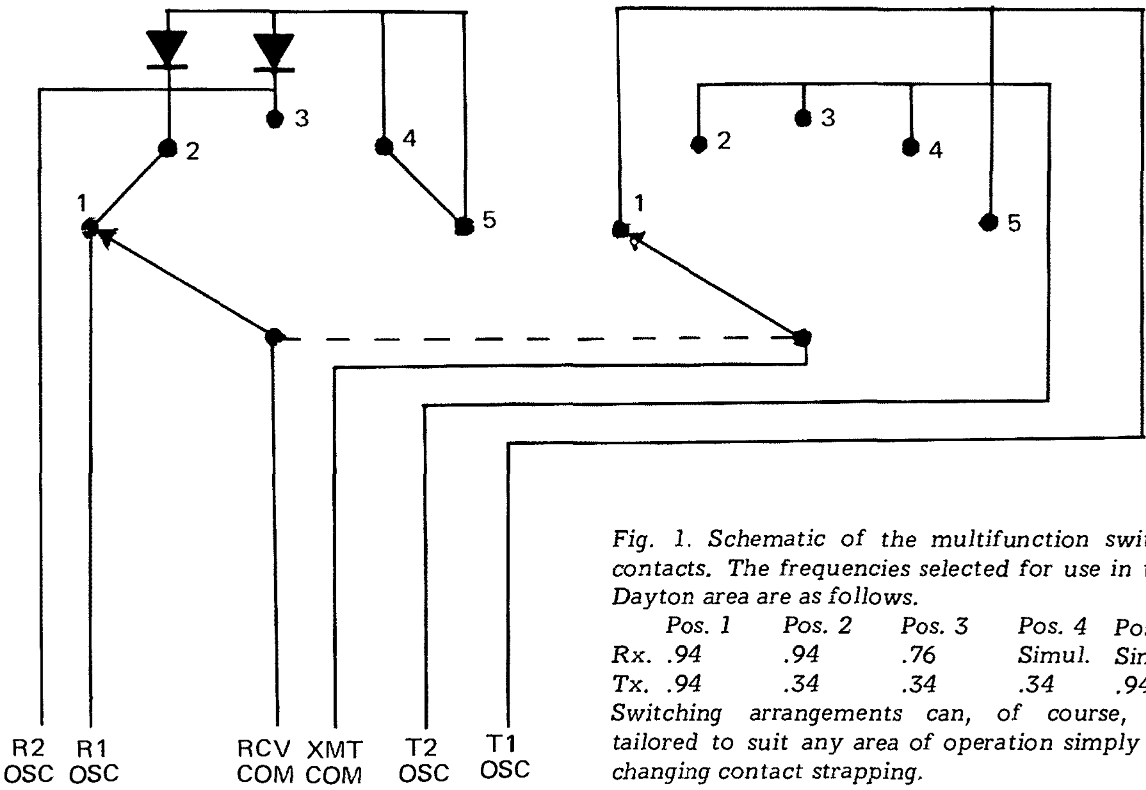
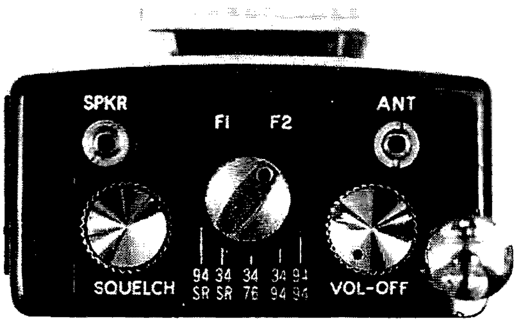


Fig. 1. Schematic of the multifunction switch contacts. The frequencies selected for use in the Dayton area are as follows.

	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5
Rx.	.94	.94	.76	Simul.	Simul.
Tx.	.94	.34	.34	.34	.94

Switching arrangements can, of course, be tailored to suit any area of operation simply by changing contact strapping.



Top plan view of the modified unit, showing the switch modification. The HT illustrated was originally set up for two-frequency transmit, so no hole drilling was required in this case. Note the knob clearance to the ridge at the back edge of the case. This should be about 1/16 in. when a "stock" knob is used.

to buy it, but it contains a wealth of data on your radio, including some excellent views of the transmitter and receiver boards. These would be impossible to reproduce legibly in reduced magazine size, so make sure you have this material available when installing the conversion. Since the one thing that Motorola did not include in the manual is a diagram of the physical location of the transmit and receive oscillator decks, these are shown in the photos.

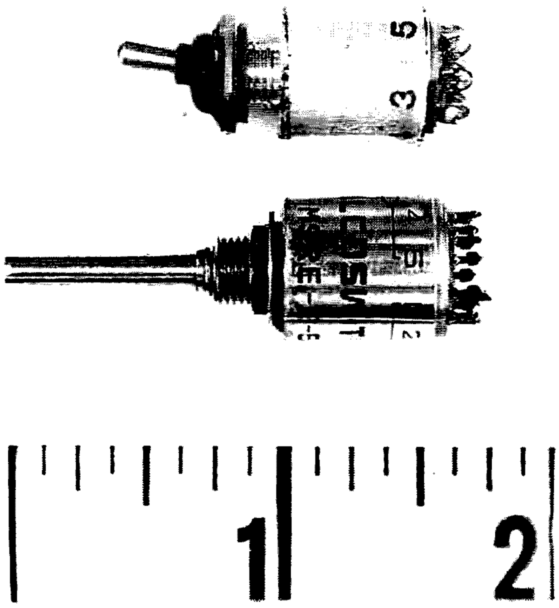
If, after reading the manual and viewing the condensed innards of your "brick" you are thoroughly terrified at the thought of touching a soldering iron to any part of it, take heart. There is nothing there that you won't find on the underside of your T-43 mobile. It's just that what is there is a lot smaller and a heck of a lot closer together. Have a magnifying glass and tweezers available, in addition to your pencil iron, and don't try to do the whole job in one sitting. Incidentally, the manual has some excellent hints on soldering to miniaturized circuits in the introductory section.

Of course, you're going to need some essential parts to do the job and one of the first things you will want to order will be crystals – precision grade. Supply your crystal manufacturer with the Motorola type number and the channel frequency and they'll do the rest. For the receiver, specify a type YMW-35 and for the transmitter a YN-19. When Motorola supplies the transmit rocks, they are shipped with a thermistor temperature compensator soldered across the leads. I have been using crystals without thermistors supplied by both Sentry and International into a narrowband system for some time with no degrading effect, so I would advise you to save a few bucks, at this stage, and request non-thermistor-compensated crystals. Expect to spend $14 to $18 a set.

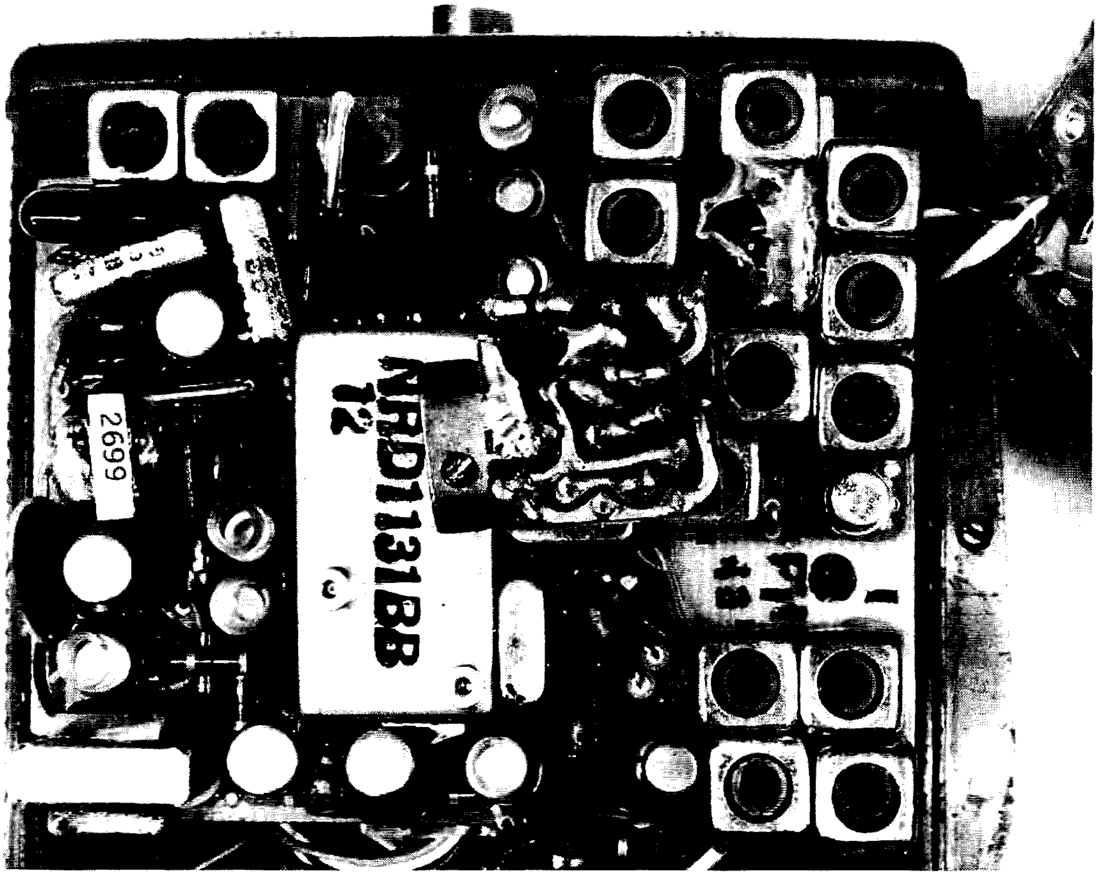
From Motorola you'll need the transmitter and receiver oscillator decks, numbers NLN6415A and NLD6221A, in addition to the manual. I also ordered the frequency selector knob (number 36C82659D01), as this size knob can be a hard item to locate and it gives the job a factory finish. All this material, including the manual and shipping charges, should cost under $35.

The switch used in this conversion is an Alcoswitch MSRE-2-5 (2-pole, 5-position rotary) and is an exact replacement, sizewise, for the toggle switch used by Motorola. I obtained our switches through the industrial department of a local electronic parts supply house for about $4.50 each.

If you plan to utilize the simul-monitor



Relative size comparison of the standard Motorola two-frequency switch (top), and the Alco 2-pole, 5-position replacement. The new switch even maintains the water-resistant specs of the unmodified HT-200.



The receiver second oscillator is the small square board with the foil side facing upwards, just to the right of the filter (NRD1131BB) in the center of the board. The assembly is held in place with the screw just to the left of the board.

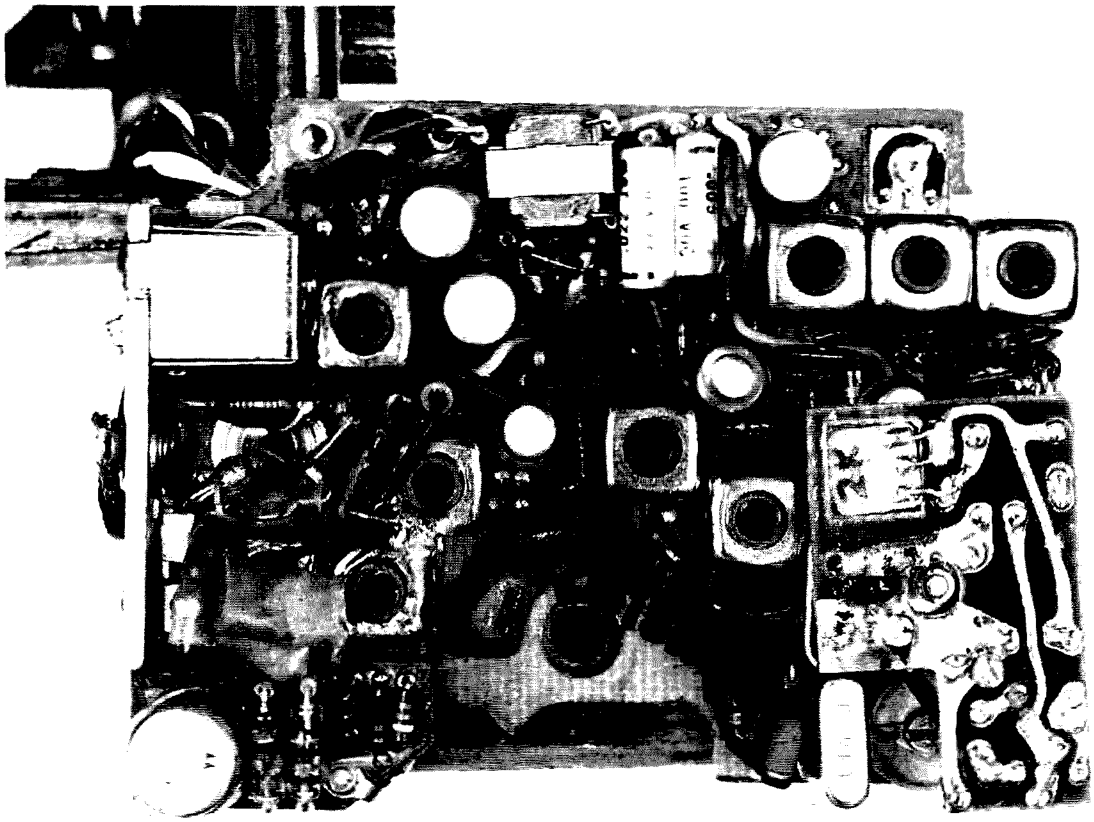
feature, you'll need a couple of small diodes. Anything that will handle a mil or two with a low forward resistance will do. I used HEP 170s simply because they were handy and small.

Installing the oscillator decks on their respective boards is a simple and straightforward job, if you follow the diagrams in the manual carefully. There are several different receiver board schematics covered in the manual, so make sure you pick the right one. Use the number stamped on the Permakay filter for reference. Since both the transmitter and receiver oscillator boards are supplied with all interconnecting wiring cut to length, it is merely necessary to locate the connecting points on the boards and "tack" the wires in place. Refer to the oscillator photos for the physical location of the assemblies. Notice that the boards are mounted "upside-down" in relation to the transmitter and receiver sections and that the interconnecting wiring is pushed through holes provided in the boards. After wiring the decks in place, be sure to disconnect the single-channel jumpers. There are two on the receiver board, so make sure to get them both.

Installation and wiring of the switch is probably the hardest part of the operation. The switching system used in our area is shown in Fig. 1. Simultaneous monitoring is accomplished in positions 4 and 5 by paralleling the receiver oscillators through the diodes. These must be used to isolate the two oscillators in positions 1 through 3.

It is strongly suggested that the switch be wired before installation into the radio. Check your wiring with a VOM and then pot the terminal end of the switch with RTV or similar material to prevent possible shorts. It also helps to make sure all leads are properly identified.

It is a good idea to cut the switch shaft to length to allow it to be inserted into the radio easily. For the knob suggested, the



Transmitter second oscillator board shown positioned over the transmitter module. The oscillator deck is in the lower right hand portion of the photo with the foil side of the board facing up.

shaft length should be about 3/16 in. This operation should be handled with considerable care to avoid snapping the shaft where it goes into the switch body.

Drilling the hole in the top of the HT case is a job that also should be approached with considerable finesse. The hole should be drilled midway between the volume and squelch knobs and 5/16 in. away from the raised area toward the back of the radio. Remove the transmitter board from the case and check to make sure no wires will be hit when drilling through from the top of the case. Using a ¼ in. drill, carefully and slowly make the hole. This is relatively soft plastic, so don't use excessive pressure. A slip at this point could bring out latent suicidal tendencies.

Install the switch and replace the transmitter board to check clearance. It may be necessary to slot the mounting hole slightly with a file to obtain a proper fit. Route the switching leads to their respective boards along the same paths as the original wiring. This is not critical, since no rf is present, but should be as neat as possible to avoid clearance problems. Soldering the leads to the boards and installing the knob should complete the job.

Owners of the PT series of Motorola portables can perform the same conversion described above, as the receiver and transmitter-exciter boards are essentially the same. In these units, however, a Centralab PS105 switch is used instead of the Alcoswitch listed.

I have personally performed this conversion on a half dozen HTs and PTs in recent months and have been using the system in my own units without problems. Checked on a Measurements Model 80 signal generator, receiver sensitivity is degraded about 0.1 to 0.2 μV, which is unnoticed on all but the weakest signals. Maximum sensitivity can, of course, be restored by switching to one of the single-channel receive functions.

. . .K8YQH■

Facsimile for the Radio Amateur Part II

Bob Dean,
Alden Electronic & Impulse
Recording Equipment Co., Inc.

As mentioned in the first part of this article, to copy weather maps and Wirephotos you must have some sort of general coverage receiver, which is stable, reasonably sensitive and selective and has the capability for copying sideband. One such as an R-390 or Collins 51S1F is ideal, but a more inexpensive receiver will occasionally suffice. On many stations, I have received excellent copy using a $100 set. Naturally, the better equipment yields consistently high quality copy. The same goes for an antenna. You can get by with a long wire, but your beam would enable you to produce much better copy. Finally, some sort of converter (Fig. 1) is required to obtain the correct input for the fax recorder. I modified the circuitry of a commercially available model by removal of the tuning indicators. (I use a scope on the output). Using many junk box parts and a few I had to buy, the converter cost about $20. You may be able to locate a converter in the line of military surplus even more

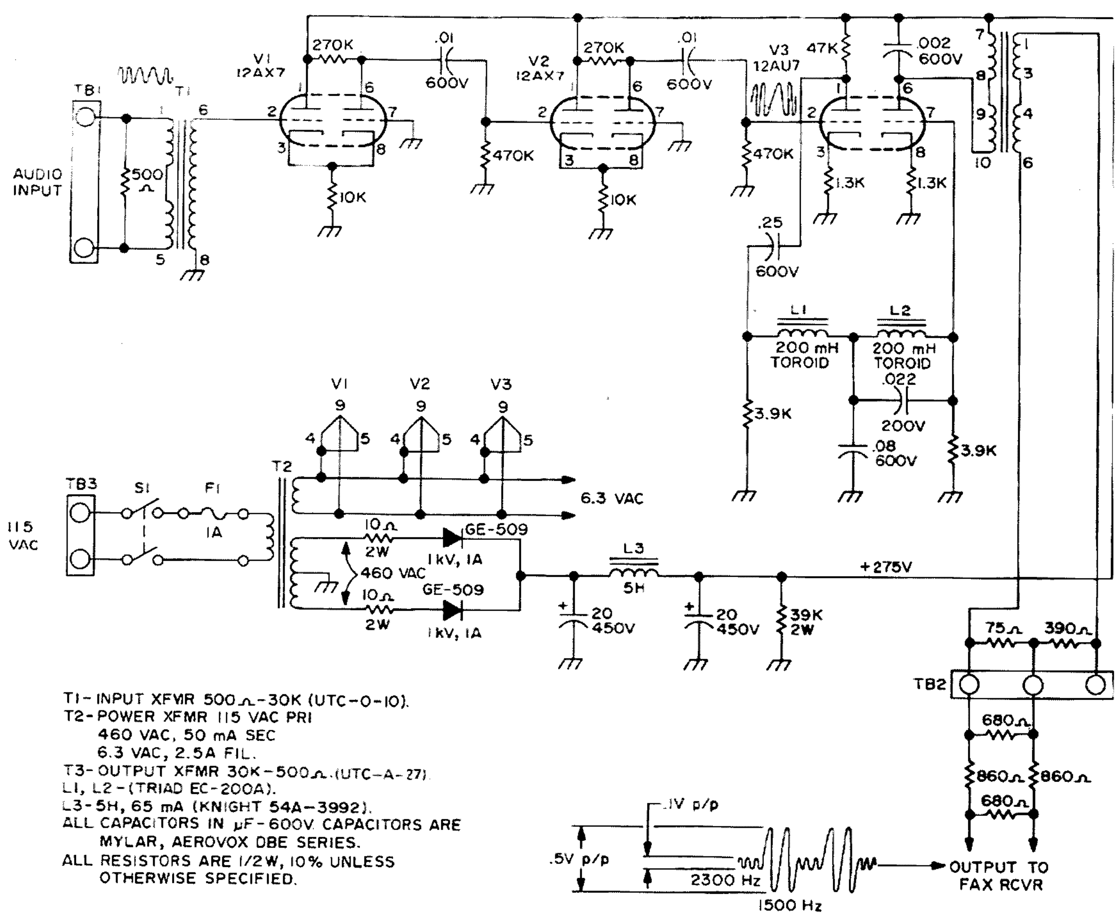


Fig. 1. Fax converter.

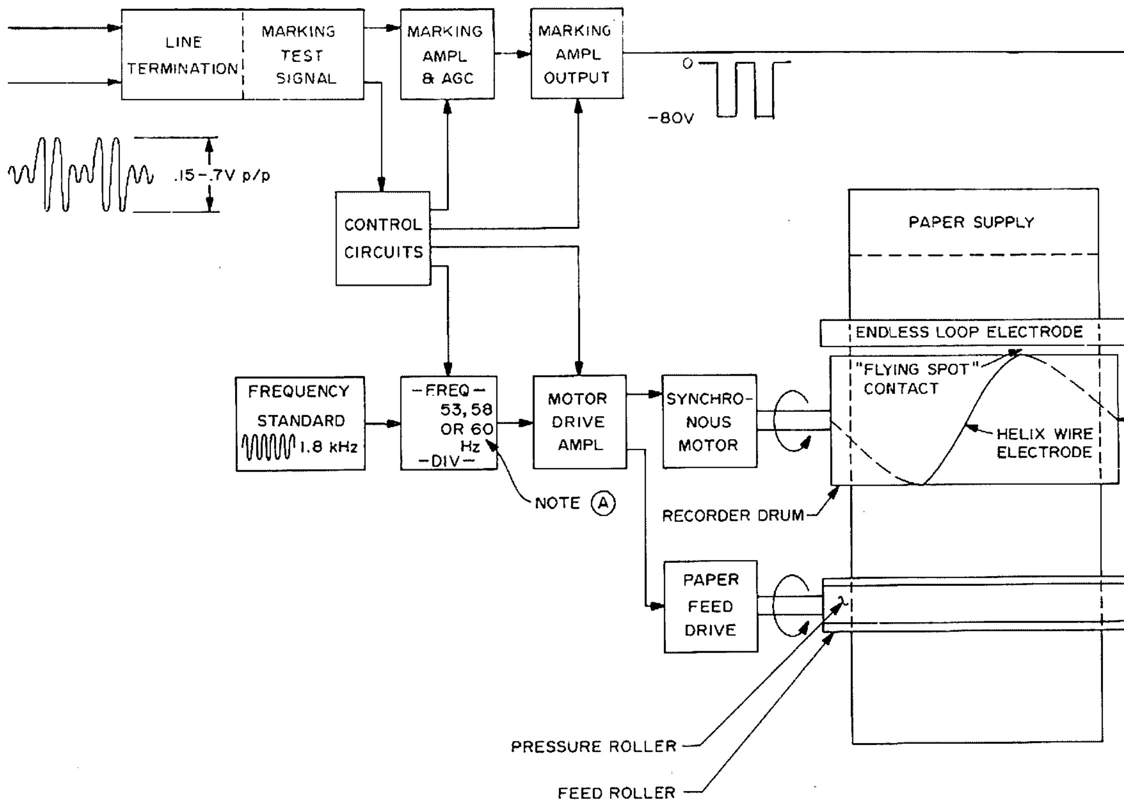


Fig. 2. Block diagram of typical recorder with mechanical components.

inexpensively so there are a few models listed in Table I.

A properly operating fax converter should have an output level that varies linearly with respect to the input frequency. This is especially important in obtaining the tonal shades in Wirephotos. For a quick check, merely apply an input from an audio signal generator. Working in 100 Hz steps throughout the input range, monitor the output and graph frequency versus the output level.

The input level required by most facsimile recorders is 0 dBm and below. If the output is taken across the 75Ω resistor in Fig. 1, nearly 0 dBm is attainable. Since many recorders require a much lower signal level, an additional attenuator network must be used to provide the proper amplitude signal to the recorder.

Recorder Operation

In Fig. 2 the block diagram of a typical recorder and a representation of the mechanical components is provided. As in the transmitter, the frequency standard is of primary importance. It ensures that the helix drum will be maintained in sync with the transmitter. With reference to Note A in Fig. 2, the output of the divider block provides different frequencies to the motor drive amplifier. Normally the output frequency used to drive the synchronous motor will be 60 Hz; however, during the starting sequence it is necessary to bring the helix drum of the recorder into coincidence with the transmitter. In this method the synchronous motor is initially started by switching it across the ac line. At this point the phasing signal is received. The divider will drop the output to 53 Hz and the synchronous motor is now switched to the output of the motor drive amplifier. Since the drum of the transmitter is revolving at a constant speed, the drum of the recorder gradually approaches the point of coincidence. As the recorder drum approaches within several degrees of this point, the output of the divider is switched to 58 Hz (this decreases the speed difference between the recorder drum and the transmitter and permits greater accuracy in the phasing of the recorder). At the instant coincidence is reached, the divider output is changed to 60 Hz, and here it will remain until the recorder is shut down or a stop tone is received.

Table I, Facsimile Equipment

Mfg.	Desig.	RPM	LPI	Type
Alden	319EA	60/90/120	96	Continuous Roll, Auto. Electrosensitive 19"
	319EA ("C" Series)	60/120	96	" "
	9217B	60/120	96 or 48/96	" "
	9244	120/240	96, 48/96 or 96/166	" "
	9244MD	60/90/120	48/96	" "
	9244T	120/240	96 or 96/166	19" Transistorized
	9255F	120/240	75/96/166	11" Transistorized
	9225E	120/240	75/96/166	11" Transistorized
	AN/GXT-2 (9165 KTL)	60/120 or 120/240	48/96/166	19 or 11" Format – transmitter –
Muirhead	D-649G/A	60/90/120	96	Continuous Roll, Auto. Electrosensitive 19"
Times Fax.	TXC-1 (TT-321)	30/60 or 60/120	96	XMIT or RCV, photo or electrostatic, single sheet capability
	RD-92	60	96	Single sheet electrostatic copy
	RD-92A	120	96	" " "
	RO-160	60/120	96	" " "
	RO-172	90/120	96	Single sheet
Westrex	UXH-2	60/90/120	96	Continuous Roll, Auto. Electrostatic copy
	UXH-2B	60/90/120	96	Electromechanical copy
	CV-157A	FSK Conv.	2300–3100 Hz, Input Limits	
	CV-157	FSK Conv.	1500-2300 Hz, Input Limits	
	CV-1066A	FSK Conv.	2300-3100 Hz, Input Limits	
	MD-168	FSK Keyer		Fax output freq: 1500-2300 Hz

Assuming that the recorder has been phased and is running at the proper speed, the quasi-sinusoidal amplitude modulated input signal containing image data is applied to the marking amplifier. The output stage of the marking amplifier applies negative going pulses to the helix wire electrode. The helix wire electrode, which is attached to the revolving helix drum and the loop electrode, form a "flying spot contact" with the electrosensitive paper. The loop electrode deposits ions on the paper which causes a mark wherever a signal appears on the helix wire electrode.

The density of the mark varies with the magnitude of the signal voltage on the electrode at a given point; however, the paper is not necessarily linear in producing a mark, with respect to the input signal. Several types of paper are available, one of which enhances tone shades and one that strives to produce strictly black and white copy. This is beneficial as it limits background noise on the recorded copy.

In recorders designed for map and APT reception, the signal to the helix wire electrode is inverted in the marking amplifier in the APT mode. In the map and Wirephoto transmissions, black signal elements correspond to maximum amplitude carrier and at the output of the marking amplifier (in most recorders) this is the maximum voltage applied to the paper. For APT transmissions, just the opposite, black elements are of minimum carrier amplitude but still require the maximum voltage to mark the paper.

Selecting a Recorder

Of primary consideration when selecting the recorder is determining what service it will copy.

I'm partial to recorders using the electrosensitive process (Alfax Type A paper) primarily because they offer a wide range

of tone shades. Also, the recorded mark is light-proof and smudge-proof. There are many types of surplus recorders available (Table I again). They are of single sheet capability or offer a continuous recording by means of an internal paper supply.

The speed, paper feed rate, and copy size that can be obtained are also important considerations. For instance, if weather maps or general all-around versatility are required, it would be advisable to select a 19" format recorder which is capable of copying 60, 90 and 120 rpm at 48 and 96 lpi. This will allow you to record almost any maps sent by radio fax. The primary operating speed is 120 rpm at 96 lpi. You could also use a recorder with an 11" format to copy these maps as long as the speeds were attainable. However, the paper feed rate to obtain a symmetrical copy must be 166 lpi (corresponds to 96 lpi transmitted on a 19" format) or 82 lpi (which corresponds to 48 lpi on the 19" format).

If Wirephoto pictures are to be copied, a recorder that operates at 60 rpm (19" format about 72 lpi or 11" format approximately 120 lpi) is required. Actually the 11" recorder appears to be standard for this type of reception, but I've received many good pictures from the 19" unit.

For Wirephoto reception you may obtain a 19" recorder which was originally designed to copy weather maps that will provide the correct speed and approximate paper feed rate without modification. This recorder (Alden Model 319A), like my own, is one of the older models. It has a mechanical shift motor drive and a separately selectable mechanical shift paper feed. The unit will run at 60 rpm and approximately 72 lpi if the paper feed selector is placed in the position normally used when running at 90 rpm. (Similarly, 60 rpm operation at 48 lpi would be attainable to copy weather maps by running the paper feed unit at 120 rpm). This is possible simply because the paper feed rate in this unit is independent of the motor drive. Using this type of setup leaves one final problem, that of a mirror image. There are several solutions to this and they are discussed at length below.

I could go on describing the requirements for each individual situation, but in preference to this I made up a table (Table II) which contains all of the data you are likely to need in selecting the correct recorder.

Mirror Image

Both the weather services and wire services make use of similar equipment. Both can be copied using essentially the same techniques. The only problem I have encountered is that referred to as a mirror image. Basically, it means that if a standard weather map recorder is used on Wire-

Table II. Fax Recorder Selection Data

Service Copied (Recorder Requirements)		Speed	LPI	Copy Size
ATS Satellite	Mosaics,	240	75	11" Recorder
	Experimental	240	96	
		240	166	
	Chart Relay	120	166	11"
		120	96	19"
APT Satellite	PIX	240	75	11"
	DRIR (150° sweep)	48	82	11"
Wirephotos	(Mirror Image)	60	72	19"
		60	120	11"
Weather Maps		60/90/120	48 or 96	19"
			83 or 166	11"
Amateur Fax		60/120	96	19"
SSTV and other experimental usage		Standard 19" recorders operate at up to 960 RPM @ 96 LIP and @ 48 LPI and the smaller recorders go 3600 RPM on a 2" format so there are many possibilities.		

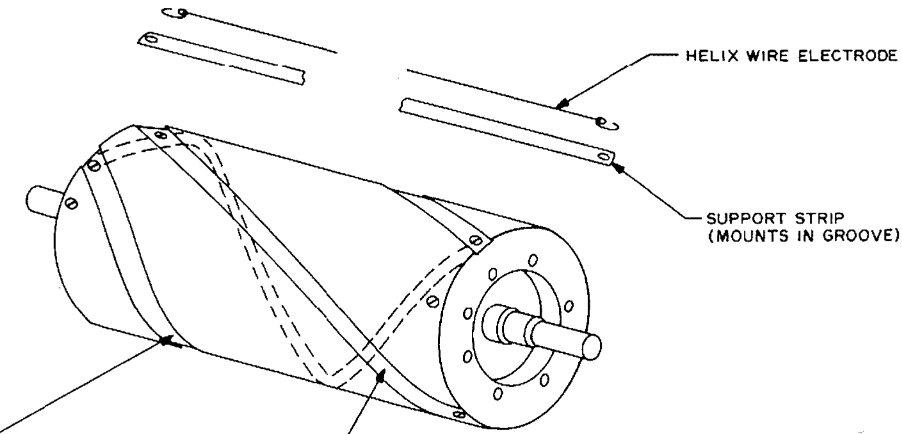


Fig. 3. Mirror image correction method.

photos the pictures come out reversed with respect to left and right. There are ways to correct this problem in some recorders.

The electrosensitive paper I use is translucent so if the recording is made using a standard weather map format recorder, the copy will be reversed, but if you turn it over and provide backlighting the image will appear as it would in the newspaper. This is by far the easiest solution.

A more correct method would be to use a printing device constructed just in reverse of the standard model (see Fig. 3).

This may be difficult to construct at home, but it could probably be obtained to fit one of the surplus ALDEN recorders.

In another printing method three styli are used; they rotate on a steel band or cogged belt so that one is in contact with the paper at any given instant. To correct the mirror image in this type of machine, the reversal of the direction of rotation is the answer. It would also be necessary to change the stainless steel plate to the other side of the paper. The function of this plate is to allow the styli to get onto the paper without grabbing the edge, and causing "jitter" in the recording.

Due to the type of paper used, backlighting will have less affect in allowing the image to show through. If you have this type of recorder and don't want to make any mechanical changes, just hold the copy up to a mirror to read the caption. It will make little difference to the viewer that the picture itself is reversed when viewed normally.

Still another type of recording technique (Fig. 4) involves a single sheet of copy clamped by one end to the steel recording drum and uses electrostatic paper. This method has an electrode which burns coating from the paper stock leaving a mark. This particular type of recorder would have to be completely redesigned mechanically to correct the mirror image.

The drum would have to revolve in the opposite direction which means the stylus must be reversed and the paper clamped to the drum on the other side. Possibly the drum could be turned end for end which would take care of the clamp problem; but the mechanics of reversing rotation, I'd leave up to you. Again, you could make use of the mirror to view the copy as it should look as the paper will not pass light easily.

APT Operation

Unless you obtain an 11" recorder designed for APT reception, there are a few basic details that you should know about. For instance, the signal is reversed in the output stages of the marking amplifier (with respect to weather map recorders) so that minimum carrier corresponds to black and maximum carrier is white. Utilizing this method yields more detail in the lighter shades of gray. Normally 16 shades of gray are obtainable, and from the subtle differences in color in the received picture, you can determine the make-up of the land masses and bodies of water, as well as the demarkation between snow and ice. Not all

facsimile recorders will correctly reproduce these subtle color changes. In these recorders, it is necessary to change the biasing on the output stages of the marking amplifier so that the input signal will act linearly in producing a mark. This is referred to as gamma correction. If gamma correction circuits are not utilized you may expect an APT picture which has both the black and white portions but very few middle shades.

Another factor to be considered is that of Doppler Shift. (This shouldn't pose any appreciable problem to the amateur; but it is included to explain its affects.) On an orbit where the satellite is passing nearly overhead you will note that the recorded pictures will display drift in one direction, then run straight, and finally drift the opposite way. Now, drift in the recorded copy generally indicates that the standards of the transmitter and recorder are not matched. In this case, however, the satellite is approaching your location at a relatively high velocity and departs the same way. Here we have the greatest amount of Doppler Effect on the signal and consequently drift first in one direction, then the opposite way. While the satellite is nearly overhead or passing to either side, on the horizion the relative velocity is quite low, hence the Doppler Effect is not as pronounced in the recorded copy. Commercial units compensate for the Doppler Effect by using an AFC. Here the input signal may be amplified, then limited, to remove all modulation and used as the drive signal, bypassing the standard. Another method is to use this signal to control another oscillator which provides the drive. In this manner, if the input signal is lost for an instant, the recorder will not change speed appreciably. Using an AFC in this case is possible because of the relatively low noise path from the satellite due to use of VHF-FM along with noise filters for removing all but the 2400 Hz signal.

Besides the recorder, reception of APT pictures will require more specialized equipment. An FM receiver, operating from 135 to 140 MHz, preferably crystal

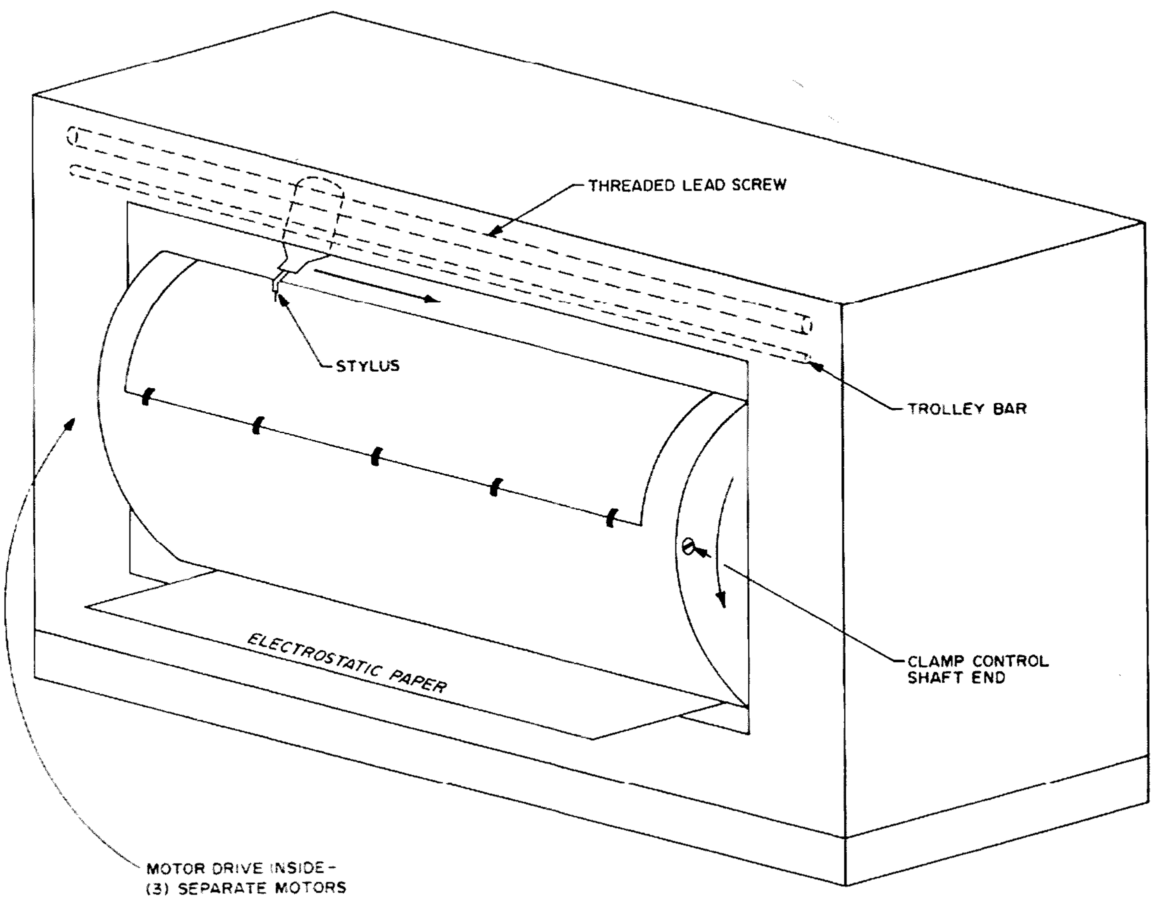


Fig. 4. An electrostatic recorder.

controlled, is a necessity. I mention a crystal controlled FM receiver primarily for convenience; actually a tunable set can be used if you have an accurate method of placing it nearly on frequency before the acquisition of the satellite you wish to copy. I experimented with inexpensive, commercially available VHF FM receivers some time ago and found the GE ER-52A has the necessary requirements.

Antenna

As far as antenna elements are concerned, you could probably construct one without much effort. The antenna normally used is a 10 element, half-wave cross-yagi with phasing harness to provide right-circular polarization for optimum reception. Or, if you prefer, the Cush-Craft people make just such an antenna.

As far as transmission line is concerned, RG-214 should be run right up to the base of the azimuth rotor, where mechanical considerations necessitate the use of the more flexible RG-58 for the connection with the antenna elements. Even though low loss cabling is used, it is advisable to install a pre-amp between the RG-214 and RG-58, although it may not be necessary if an extremely short run of transmission line is used.

Most commercially available systems supply pre-amps with cable runs of less than 100 feet. In many cases, the extra gain will not be required but in typically noisy locations it will be appreciated if not essential!

The ATS is in synchronous orbit and does not require a movable antenna, however, if you are attempting to track the ESSA, Nimbus & ITOS satellites a trainable antenna is a must. The better systems allow 720° of azimuth rotation and approximately 190° of elevation movement. A system such as this would be prohibitively expensive for the amateur to construct so an alternate is suggested (see Fig. 5). By using two commercially available rotors (such as the TR-44) and modifying one to limit rotation to 190° you can build a suitable system. It is still not inexpensive, however.

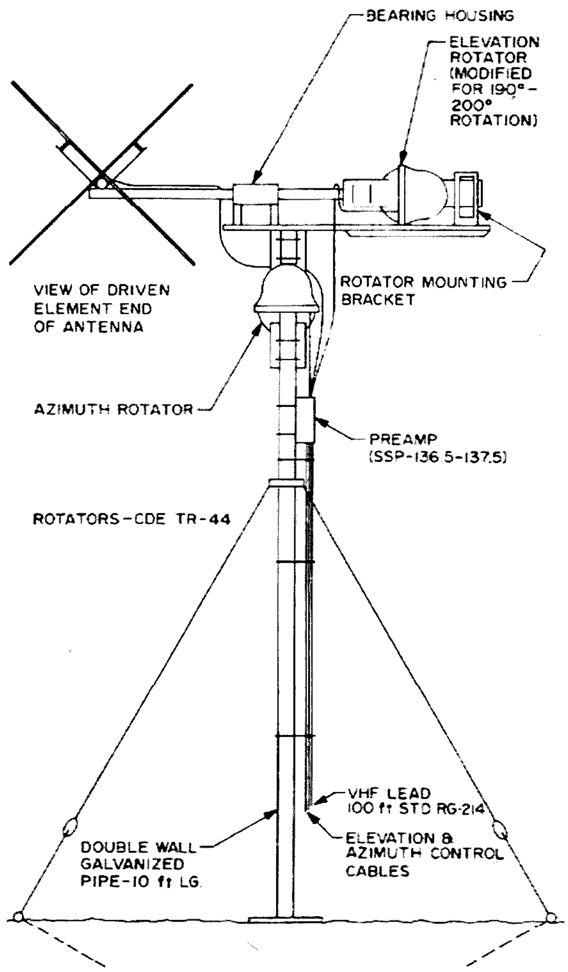


Fig. 5. Weather satellite tracking antenna.

Satellites of the ESSA class transmit a solid carrier between images almost equal in duration to that of the picture. Thus, frames from ESSA satellites have only slight area overlap. By contrast, Nimbus satellites transmit a continuous stream of pictures which result in nearly 50% area overlap. Normal speed of transmission in each case is 240 rpm and using a paper feed rate of 75 lpi on an 11" format for exact reproduction (10.2" x 10.2").

Both classes of satellites make two daily passes over the same general area, once during daylight and once during darkness. However, with a good receiving location, the satellite will often be within acquisition range for three consecutive passes. This gives the ham the opportunity to see not only the cloud cover directly overhead, but that of a wide area around him. The period of rotation varies slightly but is approxi-

mately 107 min./orbit. The ESSA type has an orbit track running generally from North to South and the Nimbus is opposite going South to North during the daylight passes.

It might also be of interest to note that the Nimbus type of satellite has the capability of recording information from an infrared scan. This is normally the mode used during the nighttime pass, but may be controlled from the ground to transmit in this mode continuously. The speed of operation for this mode (DRIR) is 48 rpm and 82 lpi on the 11" format. I must say that I have never had experience copying this infrared scanning mode but data obtained by its use (after processing) appears nearly identical to the daylight mode images. Besides the speed differences, it is of interest to note that only 150° of the scan contains useful picture data. You could use a standard APT recorder to copy the DRIR if you could change the speed; however, the useful data will be compressed. It is possible to expand this data so it occupies the entire frame. This would necessitate another type of printing helix which would sweep completely across the frame in 150° of the drum rotation. Thus, for 210° of the scan line no electrode is in contact with the paper, hence the useless data (where the inside of the infrared scanner housing, and area beyond the earth horizon are scanned) is eliminated. Also, the marking signal level must be reduced to keep the same image density as the relative marking speed was lowered.

Operating Frequencies

A few of the most common operating frequencies are listed here to save you from searching for them; although, this will be necessary for Wirephoto frequencies as many of them are changed periodically depending on the propagation conditions.

Satellites operate at 135.6 MHz, 136.95 MHz, 137.50 MHz and 137.62 MHz for the ATS, Nimbus, ITOS and ESSA respectively. Information pertaining to the orbits or plotting data for gridding is obtained by contacting:

National Meteorological Center
Environmental Science Services Adm.
Suitland MD

or contact:

Nimbus Project Code 450
National Aeronautics & Space Adm.
Goddard Space Flight Center
Greenbelt MD 20771
Attn: Nimbus APT Coordinator

They will be able to advise which publications should be obtained.

Now, for a few of the common frequencies used to transmit weather maps: NSS Washington DC keys several frequencies and most are up continuously.

3,357 kHz, 4,975 kHz, 8,080 kHz, 10,865 kHz, 16,410 kHz and 20,016 kHz – maps originate from Suitland MD or FWC Norfolk VA.

CFH Halifax NS keys 4,271, 9,890, 13,510 and 17,560 simultaneously. Maps are transmitted every hour on the hour. RTTY transmissions are made on the same frequencies, usually immediately preceding the fax portion of the broadcast. If you want to try a little DX on fax, Fleet Weather Central, Rota, Spain keys this group of frequencies. Most of them are up and keying continuously: 3,713, 5,420, 7,417, 9,875, 12,145, 15,941.5, 19,019 kHz.

Further information on fax frequencies in use can be obtained by contacting:

U.S. Naval Oceanographic Office
Washington DC

Ask about publication H0118A, Section 4. This contains all data pertinent to fax weather broadcasts for eastern North America, Europe and Africa. They have another publication dealing with the Pacific as well. You might be interested to note that the other sections of this publication contain data pertaining to all other radio weather broadcasts, both RTTY and CW. They also have a section on interpreting data from both the maps and RTTY broadcasts.

In conclusion, hopefully, this conglomeration of details and basic facts dealing with facsimile have served to answer at least a few of your questions pertaining to the subject. Now, the main intent in

writing the article was to provide you with enough facts so you could start exploring the field.

I bought one of the oldest machines ALDEN is offering as surplus because it provided the features I wanted, and with a few hours effort it's working like a new machine. As far as parts availability is concerned, any facsimile recorder has wearable parts. Many of these could be fabricated locally, but some of the very old World War II vintage military recorders probably will give you a difficult time locating any ready made spare parts.

All in all, if you are interested by all means be selective in any surplus you might obtain. Let's face it, if it won't be able to copy what you want or if you can't get spare parts easily it's not going to be much of a bargain . . . or much fun!!

Glossary of Basic Terms

Drum Speed – speed of rotation – **RPM**.

Paper Feed Rate – longitudinal copy speed.

LPI – lines/inch – number of scan lines per inch of copy.

APT – Automatic Picture Transmission (satellite cloud cover).

ATS – Applied Technology Satellite (relay satellite).

Electrostatic – method of printing involves burning of coated paper with controlled arc.

Electrolytic, Electrochemical, Electrosensitive – printing of paper by passing dc through it, which leaves a mark due to chemical action.

Electromechanical, Pressure Sensitive – two rolls of paper are fed together, a bond paper roll beneath a layer of carbon paper. The marking impulse causes a solenoid type printing stylus to strike the paper leaving a mark.

Helix – a printing electrode generally associated with the electrosensitive method.

Stylus – a printing electrode used singly or in groups of 3 (per machine).

Tuning Fork – usually used for an internal standard.

Drift – a problem most often noticed at the recorder. The copy runs off one side of

the page or the other. It may be that a difference exists between the standards of the transmitter and recorder or may be due to a mechanical bind. To make certain the recorder is not at fault, try copying another station or one of the time standards. If the copy then runs straight the problem is at the transmitter. If not, check your recorder. (Note: different when copying satellites. See problems caused by Doppler Shift).

Skew – another term for drift.

Phase, Frame or Sync – basically all describe the signals used to center the image on the recorder.

Sync Motor – synchronous motor used in nearly all facsimile equipment to precisely control drum speed.

Lead Screw – device on transmitters of the drum type which supports the drum, is rotated by the sync motor and is threaded to effect the longitudinal motion of the copy.

Half Nuts – usually made of brass, these engage with threads on the lead screw. To provide longitudinal motion.

Stepping – abrupt shift in copy usually due to defective divider chain, bind, power fluctuation, etc. Check same as for drift.

Jag – Jitter – minute steps in copy usually due to a mechanical bind. Looks like a saw tooth edge on all vertical lines. May be transmitter or recorder. Check same as for drift.

Line Grouping – problems with this generally in 3 styli recorders where all 3 are not all at the same height. Usually every third line there will be a horizontal gap in the copy.

Gamma Correction – most any recorder will produce gray shades between black and white. Gamma correction is a change in the bias of the marking amp output stages which makes the recorder show linear differences in density with respect to the input level.

With this collection of terms, you have the basics with which to discuss almost any aspect of facsimile, including any problems you might encounter.

Dean■

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Man-Made Interference
Its Causes and Cures

Every amateur, at one time or another, has experienced poor reception as a result of interference from man-made sources. This is not to be confused with interference in the form of QRM from other amateurs. That's a subject in itself. The problem referred to is interference in the form of QRN created by electrical sparks, spurious radiations, or electrostatic discharges. More commonly, it is referred to as "static."

The fact that noise can be a serious problem is evidenced by the number of receivers on the market today with some form of noise limiting circuitry. However, few of these receivers can filter out all forms of noise completely without sacrificing receiver sensitivity. That's the reason why most manufacturers specify receiver sensitivity as . . . "so many microvolts for a 10 dB signal plus noise-to-noise ratio." This is the minimum acceptable level for the exchange of intelligence in communications. As the noise level increases, the incoming signal strength must also be increased to maintain the minimum ratio. This background noise level can come from one or more of the following sources: (1) cosmic radiation from outer space, (2) terrestrial "atmospherics" due to lightning and similar types of electrostatic discharge, (3) internal receiver noise that is a function of its design, and (4) man-made interference. The first two sources mentioned, cosmic and atmospheric noise, are completely beyond our control. In regard to the third source, most manufacturers have done an excellent job in designing receivers with low internal figures. This leaves the last major source – man-made noise – as the only area that can be controlled to insure reliable communication.

This article will therefore propose methods of locating and eliminating sources of man-made interference. Definitions, descriptions, and causes of interference will also be covered.

During the past couple of years, while working for a local power company, this writer has been involved in numerous attempts at locating and eliminating noise sources along power lines and in consumer locations. Through these experiences it can be concluded that man-made interference can occur at any hour of the day or night, can be steady or intermittent, can come from every imaginable source, and is not always easy to locate. While man-made noise sources appear to be elusive, they have a few things in common that make the hunt easier: (1) They are all the result of an electrical spark, spurious rf energy or an electrostatic discharge; and (2) all sources are reasonably close to the receiver experiencing the interference.

Spark Discharge Noise

Webster's dictionary defines noise as

"... unwanted signals in an electronic communication." In a broader sense, noise can be considered anything that *interferes* with the exchange of intelligence in electronic communication. Since man-made interference falls in this category, let's look at the major types of noise.

Whenever there is a breakdown in insulation of a current carrying circuit, or the making and breaking of minute conducting paths in the components of a system, noise is generated. This type of interference is called "breakdown" or contact noise and it occurs in many different forms over a wide frequency range. Power-line interference is a major offender in this category. The

Table I. Spark Discharge.

NOISE TYPES	NOISE SOURCES	CHARACTERISTICS	REMARKS/REMEDIES
BREAKDOWN OR CONTACT	1. *Power Line*		
	a. loose connections	a. frying, low pitched	1. In all cases of Power Line Interference, the local power company should be called upon to make the necessary corrections. For safety reasons, it is best for the amateur to stay off poles and other facilities. The amateur can assist the power company by describing the noise, determining its frequency and general location. See text.
	b. loose tie wires	b. fying, low pitched	
	c. faulty insulators	c. buzzing, raspy	
	d. lightning arresters	d. hissing	
	e. loose hardware	e. popping, irregular	
	f. tree limbs	f. frying, irregular	
	2. *Thermostatically Controlled Devices*		
	a. heating pads	a. buzzing, raspy	1. Install capacitor filters as close to the thermostat's contacts as possible.
	b. refrig. butter conditioners	b. buzzing, raspy	
	c. aquarium water heaters	c. buzzing, raspy	
	3. *Other Devies*		
	a. neon signs	a. buzzing, raspy	1. Insulate neon signs completely. Bond isolated conductive material in the field of the sign.
	b. fluorescents	b. 80 & 40 meters	2. Fluorescent lights provude RF energy from 3400 kHz to 8300 kHz.
	c. Dimmer switches	c. buzzing, raspy	
	d. elect. fences	d. irregular	
	e. faulty doorbell transformers	e. intermittent buzzing	3. In the case of an arcing doorbell transformer, the entire unit should be replaced.
	f. elect. clocks	f. irregular buzzing	4. Noise generated by an electric clock can sometimes be cured by thoroughly cleaning the internal mechanism and checking the wiring.
ROTATING ELECTRICAL MACHINERY	1. *Appliances with Brush Type Motors*		
	a. elect. mixers b. elect. shaver c. vacuum cleaner d. small motors e. elect. saws	a. all brush-type motors will produce a whining type noise & produce streaks on a TV screen.	1. Install filter capacitor at motor with effective grounding. 2. Seat brushes and turn down commutator.
	2. *Ignition Noise*	a. popping noise varies/speed	1. See text.

generation of noise can result from loose connections, tie wires, or hardware; faulty insulators or lightning arresters; or tree limbs touching bare conductors.

Power Lines. Loose connections and tie wires produce a frying, low-pitched noise resulting from electric currents conducting through oxide paths or by actual sparking of the conductors. In some cases, the noise will be intermittent and will occur only when the conductors are disturbed by wind or other means. Locating the actual noise source in this situation will be a frustrating experience, but well worth the trouble if the noise can be completely eliminated.

Noise generated from faulty insulators and lightning arresters can be the result of a breakdown in insulation or from contaminants such as dirt and moisture. The sounds associated with this type of interference have a buzzing or raspy note and are usually easy to identify.

Trees touching bare conductors are a major source of noise problems.

Quite often, trees are planted near power lines and eventually come to be a problem. The branches usually grow high enough to become entangled in the bare primary conductors. The resulting noise is a frying, low-pitched type that is very irregular. However, a branch touching a bare conductor is probably the easiest situation to identify from the ground. As

Table II. Spurious Radiations.

NOISE TYPES	NOISE SOURCES	CHARACTERISTICS	REMARKS/REMEDIES
1. RF ENERGY	1. Devices Radiating RF Energy a. heliarc welder b. induction soldering machine c. diathermy machine d. TV receivers e. BC Band & Amateur Rcvrs	a. all sources produce either a whining, buzzing, whistling, or warbling sound.	a. Check the frequency and harmonics of the source. The units should be well shielded and grounded. If necessary, install traps and filters tuned to the frequency of the interference. (These remedies refer to Sources a, b, and c.) For Sources d and e, shield complete and check stages for proper neutralization.

Table III. Electrostatic Discharge.

NOISE TYPES	NOISE SOURCES	CHARACTERISTICS	REMARKS/REMEDIES
1. Static Discharge	1. Sources not connected directly to electrical circuit a. loose contacts between metal objects in electric field. b. guy wires rubbing together c. antenna lead-in wires loose. d. loose metal strap holding mast. e. belt, wheel & tire static	a. irregular, popping b. irregular, popping c. irregular d. intermittent e. popping, crackling	1. Rework and tighten all areas of metal to metal contact. Check all ground connections. 2. For belt, wheel, and tire static, bond metal surfaces together with a copper strap. Install front wheel static collectors and inject antistatic powder into tires through the valve stem.

in all cases of power-line interference, always let the power company make the necessary corrections. This is by far the safest approach to the problem.

Thermostats. Thermostatically controlled devices such as heating pads, refrigerator butter conditioners, and aquarium water heaters can also generate interference. The characteristic of this type of noise is a buzzing, raspy sound that switches on and off at a certain rate.

Other devices that can also cause problems are neon signs, fluorescent lights, dimmer switches, electric fences, faulty doorbell transformers, and electric clocks. Many doorbell transformers are located in attics along with the rest of the wiring. In hot climates, the attic can reach temperatures as high as 150–160°F. With this high ambient termperature, and the additional heat generated by the transformer itself, the insulation breaks down and severe arcing can occur. This situation is quite common in the southern states during the summer months.

Rotating Electrical Machinery. Appliances with brush-type motors are also producers of noise interference. These appliances include mixers, electric shavers, vacuum cleaners, small shop motors, and electric saws. The noise produced is a raspy, whining sound and a TV screeen would display horizontal streaks.

Ignition Noise. A discussion of spark discharge noise would not be complete without mentioning ignition noise. This type of noise exhibits a popping sound at a rate that varies with engine speed. Its intensity increases as you come closer to the source. With the exception of internal receiver noise limiting, very little can be done to control the noise at a fixed station location with vehicles traveling nearby. Sometimes a capacitor across the speaker terminals will help to eliminate the sharp impulses. Of course there are many types of suppression that can be incorporated in a mobile installation to silence the mobile vehicle itself. However, since we are discussing fixed receiver installations, the subject of mobile noise suppression will not be covered in this article.

Spurious Radiations

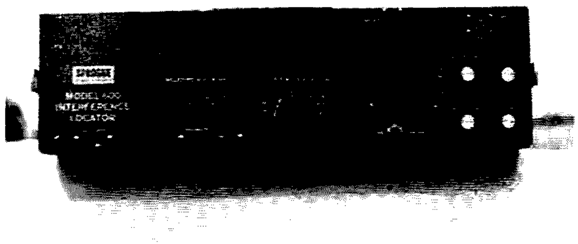
RF Energy. Devices that can radiate energy and interfere with communication are heliarc welders, induction soldering machines, diathermy machines and local oscillators in TV and other types of receivers. These noise sources are generally easy to find since they are producing rf energy at a particular frequency with harmonics. The sounds produced can be identified by their whining, buzzing, whistling, or warbling characteristics. The spurious signals are usually the result of improper or inadequate shielding or grounding and as a result may produce harmonics over a wide spectrum.

Static. Static noise results from metal objects that are not connected directly to an electrical circuit. For example, one source of static interference can come from loose connections between two metal objects in an electric field. Other sources can be guy wires rubbing together, loose antenna lead-in wires, or loose metal straps connected to a tower. Also falling within this category would be belt static and wheel and tire static. These last forms of static discharge are more pronounced in dry climates and are more troublesome in mobile installations. In most cases, however, the noise source is very close to the receiver being interfered with and consequently the noise source is easy to locate.

Locating Noise Sources

At Louisiana Power and Light Company, a Sprague Interference Locator is used to pinpoint noise sources. This receiver tunes from 550 kHz to 200 MHz continuously in five bands, has a signal strength indicator, and comes with several types of directional antennas. While the Sprague receiver performs admirably, any other receiver that has an rf gain control can be used with similar results. Also, it helps if the receiver used has a signal strength meter, a means of disabling the avc or agc circuit, and a directional antenna.

How do we find the noise? It is usually best to start first in the home that is



At Louisiana Power & LIght Company, a Sprague Model 600 Interference Locator is used. It is a battery powered receiver that tunes from 550 kHz to 200 MHz in five bands.

experiencing the noise problem. Take the receiver to the main breaker panel and cut off one house circuit at a time. If the noise persists after all the circuits have been deenergized, then it's safe to assume that the noise is not coming from a source within that home. If there are several hams in the neighborhood picking up the noise, there's a possibility that they can help in the search. By turning beam antennas until the peak noise level is reached, the general area of the noise source can be determined. However, this method may not work in all cases.

The next step is to set the rf gain on the battery receiver where the noise is just audible. It is usually best to start on a low band or frequency (80 meters is best for the first try). If the intensity of noise increases as you move through the neighborhood, you are headed in the right direction. As you get closer to the noise source, move to a higher frequency on the receiver; the reason being that the higher frequency harmonics of the noise source will travel shorter distances. Finally, you will be very close to the noise source when it can be received around 200 MHz. This is usually the best frequency for zeroing in on a noise source.

The first place to start is at the main breaker panel of the house experiencing the trouble. Here the author is working with a power company serviceman to locate the noise.

It may take many trips around the neighborhood, listening on different frequencies, and plenty of patience to find some noise sources. Intermittent noise sources may take several weeks to track down. However, to eventually locate and eliminate a troublesome noise is often worth the effort. Also, you may get a few false readings while tracking down the noise. For example, in locating power-line interference, remember that the conductors can act as a huge antenna and radiate noise over a wide area. Also, as you walk along a power line, the noise will diminish and intensify several times. This is due to the standing wave pattern that is set up on the conductors acting as a "transmission line." So don't be fooled by some of the readings you may obtain. The key words are patience and perseverance.

Recommended Remedies

Power Line Interference. Once you have determined that the interference is probably due to some portion of the power company's facilities, the best thing to do is call the local office and ask for the engineering department. Give the engineer all the information available regarding the frequency of the noise, its general location, a description of the interference, and the time of day that it occurs. Above all, leave all remedial action to the power company – they have the necessary equipment to do the job safely.

Devices Controlled by Thermostats. Should the noise be traced to a thermostatically operated device, the first thing to do is check to see if the device is operating properly. Then, filter capacitors should be installed as close to the contacts as possible.

Rotating Electrical Machinery. To effectively eliminate noise produced by brush-type electric motors, the brushes should be reseated. Then filter capacitors

It's best to leave remedial action on utility poles to the power company. They have the equipment to do the job safely.

should be installed with an adequate ground.

Spurious Radiations. Radiations from TV and other types of receivers can be eliminated with proper shielding of the unit. Also, the individual stages can be checked for neutralization. The unit should be grounded.

For radiations from rf heating and diathermy machines, first determine the fundamental frequency and harmonics generated. If the interference persists after the unit is shielded and grounded, it may be necessary to install a trap, tuned to the fundamental frequency of the noise.

Static. In regard to belt, wheel, or tire static, several measures aid in the elimination of noise. First, tighten all connections that could be a source of trouble; where necessary, bond the metal surfaces together with a flexible copper strap. Front wheel static collectors can be installed, but they should be checked every 5000 miles for wear. Also, antistatic powder can be injected into the tires through the valve stems.

Conclusion

In a discussion of this type, there's a good possibility that some of the causes of man-made interference have been unintentionally omitted. Since many of the examples listed were taken from my own experiences at Louisiana Power & Light Company in a specific locality, they cannot represent all possible conditions. You may experience a particular type of noise that is a characteristic of your area only, and does not occur elsewhere. If this is the case, the noise type will not appear in the tables, but the source can still be located by using the techniques described. This is particularly true for man-made interferences, since they all radiate some form of electrical energy. Then, with the aid of a battery-powered receiver, the origin of the noise can be easily pinpointed.

Another characteristic that helps to identify the interference as coming from a man-made device is the fact that most of the radiated energy will be vertically polarized. So if the intensity increases when switching to a vertically polarized antenna, it's safe to assume that the origin is man-made.

Since the problems of generated noise have plagued radio reception for such a long time, many amateurs have needlessly accepted interference as a fact of life. There is no question that great strides have been made in reducing background noise to an acceptable level. For example, imagine what it would be like if the rotary spark transmitters were still in operation! On the receiving end, several noise limiting circuits have been perfected that suppress many forms of noise almost completely. However, for a high concentration of noise, or for occurrences of interference that are persistent, the best solution is to eliminate the source itself. If this approach is chosen, you should find the techniques described in this article useful.

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A Linear, Stable VFO With a Tracking Mixer

Probably the heart of any receiver or sideband transmitter is the vfo. I favor the crystal-controlled first oscillator, followed by a tunable i-f with a vfo to heterodyne to the intermediate frequency. The vfo described in this article is designed to provide a good starting point for the construction of a homebrew receiver or transmitter. When set up for receiving, it takes a 6.455 to 5.455 MHz tunable i-f and heterodynes it to a fixed i-f of 455 kHz. Set up for transmitting, it heterodynes a 455 kHz sideband signal to the tunable i-f (see Fig. 1).

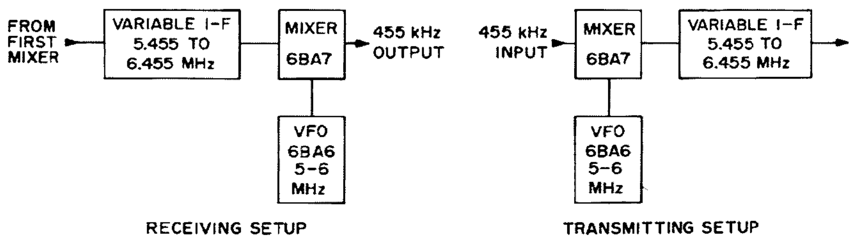

Fig. 1. Using the vfo and tracking mixer for receiving or transmitting requires only reversing the input and output connections to the mixer.

Plenty has been written about stability, so we won't dwell on that here. However, silver micas should be used throughout. They used to be expensive, but now they go for 28–36 cents. Let quality be your guide in selecting components . . . which doesn't necessarily mean a big cash outlay if you're a good scrounger. As far as mechanical stability goes, my unit is built out of 1/8 in. aluminum panel material. It's just about as solid as it can be . . . and the hacked-up fingers I got trying to cut the stuff with a hacksaw don't feel so bad any more. There are compensations for everything. In this case I can beat on the vfo and not change the frequency, so at least I know it was worthwhile!

The circuitry is quite conventional, but from a homebrewing standpoint can solve some very basic problems in getting a receiver or a sideband rig off the ground. The linear tuning is an awfully nice feature,

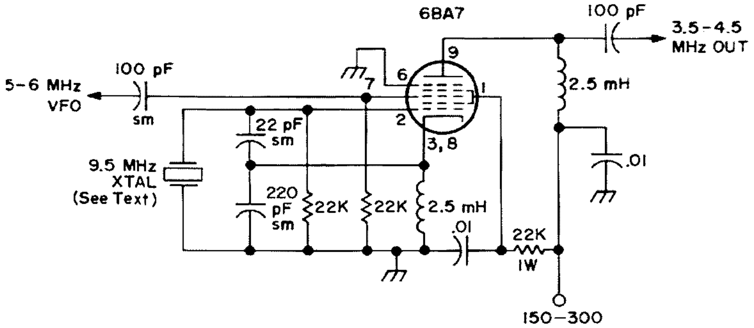

Fig. 2. Setup for calibration.

which is easier to come by than you might imagine. Obviously, the answer lies in the tuning capacitor. The one I used came out of an old Gonset 3–30 MHz converter. If I'm not mistaken, most of the old Gonsets used virtually the same capacitor, and they can be picked up for about $5, which gets you not only a first-class two-gang variable that's built solid, but a nice assortment of parts and a dandy little box for your next transistor QRP transceiver! These capacitors have about a 60:1 reduction train built right in, consisting of a miniature planetary vernier and a nice smooth gear drive. You'll find it's very smooth tuning with no discernible backlash, and it has all the

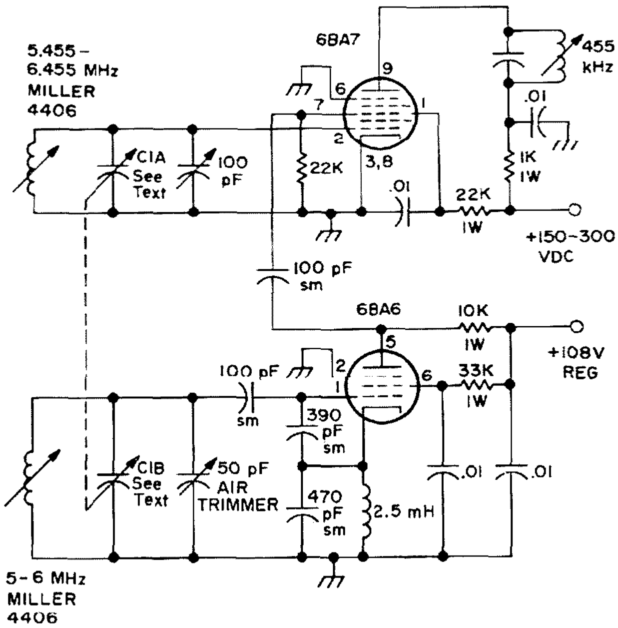

Fig. 3. The complete circuit, set up for receiving.

"Here's to lightning, static and airplanes!"

necessary dial drives built right in. So right away you've solved not only your electrical but your mechanical problems as well.

The capacitance of the particular unit I used appeared to be about 200 pF per gang. These capacitors are quite linear in the middle two thirds of their range, and adding a stop to prevent travel into the nonlinear areas is quite simple. The rotor plates are stabilized by two brass plates. All that is required is to solder a piece of 12-gage wire between the brass plates and you have a simple and positive stop against the frame. At this point, you should build for at least one hour, and be sure that your receiver is zeroed with WWV. Now comes the fun of trying to make it linear within 2 kHz. It's not as bad as it sounds, so take heart and get to work. After you've finished with this, you'll have to adjust the tunable i-f for perfect tracking. By careful bending of the split rotor plates you can get near perfect linearity of the vfo range.

Now the mixer. If you're going to use the unit in a receiver, the tunable i-f tank feeds the first grid, and the 455 kHz i-f comes off the plate . . . vice versa if you're going to use it in a transmitter. Hook it up,

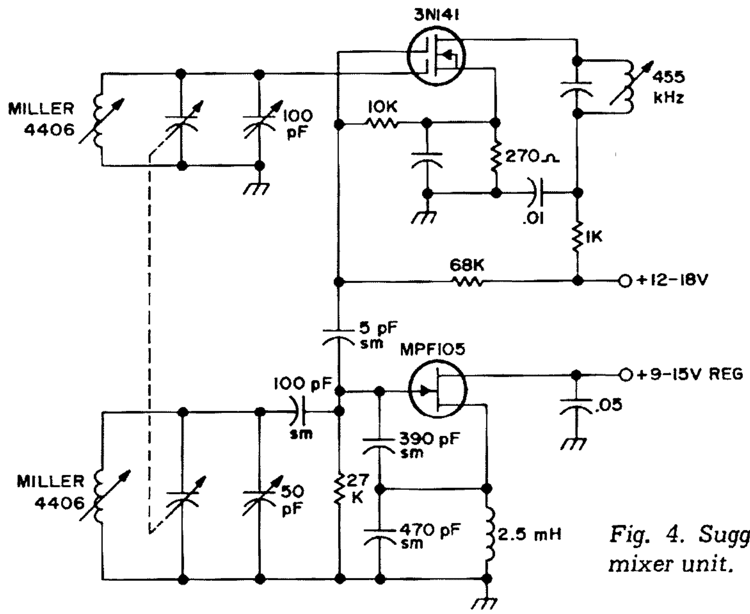

Fig. 4. Suggested solid-state version of the vfo—mixer unit.

the vfo section of the circuit. You'll find that it tunes about 3 MHz around the required frequency. This means that plates have to be removed. I'm not 100% sure that the capacitor you get from your old Gonset is going to be identical to mine, but in my case I had to remove all but three rotor plates to get the tuning range down to 1 MHz. I suggest that you do not remove all but three rotor plates before checking this out plate by plate as you remove them.

Figure 2 shows the setup I used to calibrate the vfo. If the receiver you're using has only a 500 kHz tuning range, you'll have to use a 9 MHz crystal to calibrate the upper half of the tuning range. Before you start, be sure that the receiver and the vfo have both warmed up be sure you've got the right image, and juggle L and C till it tracks the vfo. Nothing to it!

Once you've completed this unit, the hardest part of building a homebrew receiver or sideband rig is over. This comparatively foolproof circuit will serve as the heart of some very fine equipment. The linear tuning is a tremendous plus. If you want to get the jump on me, you might try using a FET for the vfo and a 3N141 dual insulated gate Mosfet for the mixer. There are many advantages to an arrangement like this, particularly in terms of spurious responses, since the 3N141 is a linear mixing device. Try the circuit of Fig. 4. It shouldn't be too far off the mark, although I haven't had a chance to play with it yet.

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GENERAL CLASS LICENSE STUDY GUIDE

Part XII Some Final Touches

We've come a long way now, and here we are at the end of our study on the General class license exam. We've covered quite a few subjects, but several questions on the FCC study list haven't fit properly into any of our groupings yet – and so in this final discussion we will take up the "miscellaneous" points we've managed to ignore thus far.

These points range from considerations of operating courtesy to those involving FCC rules and regulations. The specific study list questions are:

4. List some operating procedures which can be employed to minimize interference and congestion of the amateur bands.

11. What is a third party agreement?

22. What is TVI? How can it be remedied if the amateur station is at fault? If the TV receiver is at fault?

39. Describe the transmission characteristics of the amateur bands below 30 MHz (Mc/s). List several propagation factors that influence signal transmission and reception in these bands.

While we'll try to follow our usual practice of broadening and paraphrasing the study-list questions with these final four, they are a bit more difficult to do so with than their predecessors, precisely because they are so miscellaneous in nature.

For this reason, we may not broaden them quite so readily as we did earlier subjects. This time, we'll ask first, "How do ham bands differ?" And we won't restrict ourselves to those below 30 MHz. Then we'll brush lightly across the subject of rules and regulations by inquiring, "What are some of the rules?" We won't go very deeply into this, because while theory remains relatively constant, rules are constantly changing and anything we say may become obsolete at any time.

Then we'll touch upon good-neighbor policies with that lament of a new licensee, "What can be done about TVI? And to wrap things up, we'll ask "How can hams improve their bands?" To answer this, we'll discuss general. operating courtesies and requirements.

How Do Ham Bands Differ?

It takes only a receiver and a little listening to discover that each different ham band has a flavor all its own. That's one of the reasons why many hams settle down to operate on only one of the many available bands, and become known as "40-meter men" or "20 meter operators" or what have you.

One of the major factors contributing to this unique identity for each of our bands is that no two ham bands have identical transmission or propagation characteristics. Some are almost useless for short-range operation but perform spectacularly for long-distance contacts. Others are limited to line of sight. Operators who prefer DX gravitate to the DX bands, while those who just like to chew the rag tend to stick to short-range bands where they get a chance to become personally acquainted with their fellow ragchewers, as well as by radio.

Before we look in detail at the characteristics of each of the popular bands, let's see how radio waves in general are propagated. Earlier, we saw how waves are launched into space in all directions from an antenna, and are reflected from any

large conducting surface. This is the heart of all radio propagation, and what makes the difference between one band and another is the difference in what will reflect the wave.

When radio waves leave the antenna, they go in all directions. Some travel directly to the receiving antenna without reflecting from anything on the way, and radio engineers call these the "direct wave" while hams usually call them the "ground wave." Some travel along the surface of the ground, if the radio frequency is low enough. Almost all the ham bands are high enough in frequency that this wave is ignored by hams; engineers call this the "ground wave" (which sometimes leads to confusion when hams and engineers talk with each other). Most signals, however, radiate out into space.

If conditions are right, some of this "space wave" will be reflected by ionized layers in the upper atmosphere, from 10 to 200 miles above the surface of the earth, and will return to earth at far distant points. These signals are known as "sky wave" signals since they appear to come from the sky (because of the reflection), and are the basis of almost all shortwave communication except for the line-of-sight "ground wave" operations conducted on low-frequency bands during daylight hours and on VHF bands around the clock.

The higher the frequency of the signal, the less effective will be this reflecting action. Balancing this, however, is the fact that other ionized layers tend to absorb lower-frequency signals, so that for any specific conditions in the ionosphere, both "lowest" and "highest" useful frequencies exist. The lower end of the range of useful frequencies provides shorter range, because the more effective reflecting action will permit the signal to go nearly straight up and bounce right back down. The upper end provides greater range, because only those signals which hit the ionized layers at a relatively shallow angle (which provides a longer "skip distance") can be reflected.

Figures 12-1 through 12-3 compare the different kinds of waves used by hams. Figure 12-1 shows the line-of-sight conditions for UHF operation. In this "direct wave" type of operation, the key factor is antenna height above ground. The higher the antenna, the greater the range – for exactly the same reason that you can see farther from the roof of a skyscraper than from ground level.

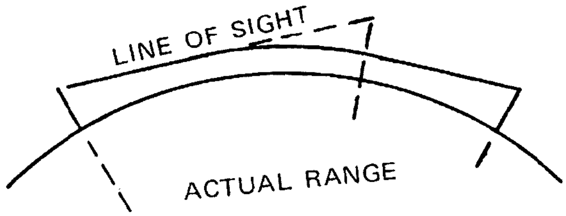

Fig. 12-1. Line-of-sight and horizon range of UHF radio waves are shown here. Curvature of earth has been exaggerated for emphasis. Key point is that antenna height above ground is virtually the only factor determining range of line-of-sight signals.

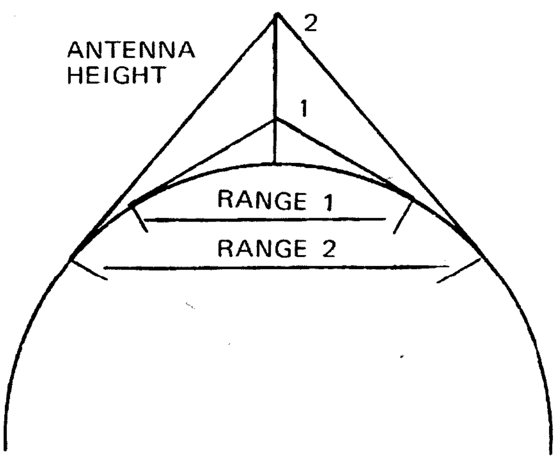

Fig. 12-2. Refraction of radio signals around earth's curvature as shown here extends line-of-sight distances in many cases. In almost all cases, actual effective range is same as it would be if earth's radius was 1/3 larger than it actually is. Weather conditions (tropo bending and "wave-guide effect") can extend range amazingly at times. 2-meter transmissions from Hawaii to California have been accomplished by this method.

At all except the very highest radio frequencies, a bending of the radio waves around the curvature of the earth occurs as shown in Fig. 12-2. The waves are still direct waves, in that they do not reflect from anything, but they go a short distance past the visible horizon (about the same as if the earth's radius was 4/3 of its actual value).

Atmospheric effects can create "ducting" or a sort of waveguide action between

the earth's surface and an air stratum, or between two different air strata, which gives the same sort of action as the refraction shown in Fig. 12-2 but actually depends upon reflection of the waves from the invisible "walls" of the waveguide. This type of action occurs reasonably frequently on VHF bands, where it is known as "tropospheric propagation" and leads to exciting DX.

The sky-wave propagation which accounts for the majority of ham long-distance operation is illustrated in Fig. 12-3. When a signal is propagated by the sky wave, it may leave the transmitting antenna at any angle from one which causes it to just graze the horizon, up to straight vertical.

A signal leaving the transmitting antenna vertically will return to earth very close to the originating station, which does not give exceptional range but makes possible good coverage of moderate-range areas.

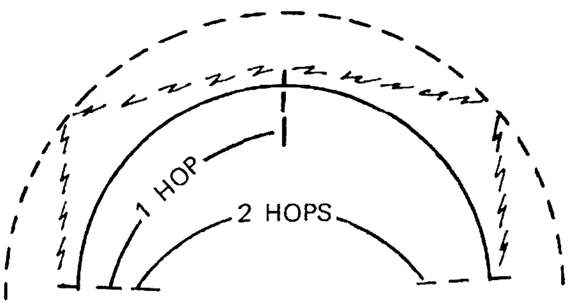

Fig. 12-3. Most ham DX depends upon reflection of radio signals from ionized layers in the upper atmosphere. This ionospheric reflection permits radio transmission from almost any point on earth to any other point, by proper choice of frequency and beam direction. Reflection is most effective in "HF" bands between 3 and 30 MHz, but sometimes occurs in 6-meter band as well.

One which leaves at the "grazing angle," however, gets the maximum range. It skims the surface of the earth at the horizon, then travels on until it hits the ionosphere at a distance from the transmitter somewhat greater than twice the distance to the horizon (because the reflecting layer is far above the surface of the earth), then is reflected at a shallow angle, and travels an extended distance before returning to earth. When it returns to the surface, it may be reflected back up for another hop, or may graze the surface and thus begin a second hop without surface reflection. Multiple-hop transmission makes it possible to reach almost any spot on the planet from any other spot by proper choice of frequency to suit the prevailing ionospheric conditions.

At least four different layers in the ionosphere (Fig. 12-4) have been identified. They are identified by letters. The D layer is the lowest of those which seriously affect ham radio signals. It's about 35 miles above the surface of the earth, and absorbs low-frequency signals somewhat like the way in which fog swallows up light. The D layer is present only during daylight hours, and makes the lower-frequency ham bands almost useless for sky-wave propagation in the daytime.

Some 25 miles above the D layer is the E layer, which is also present only during daylight (but during the winter, it may persist for several hours after sunset). This layer reflects signals which reach it, and causes "short skip." "Sporadic E" clouds are patches of extremely dense ionization within the E layer which are capable of reflecting VHF signals, and provide skip signals on 6 meters (and on rare occasions, on 2 meters as well).

Far above the E layer, at an altitude of about 120 miles, is the lower of the two F layers, called F1 to distinguish it from the 200-mile-high F2 layer. Like D and E, F1 is present only during daylight and for a short time after sunset. This layer reflects signals at higher frequency than does the E layer, and provides the majority of the intercontinental DX worked by hams during daylight.

At night, the F1 layer either vanishes or rises to merge with the F2 layer above it. This uppermost of the reflecting layers provides the longest range for signals, but is less effective at higher frequencies than are the lower E and F1 layers.

Both the frequency limits and the altitudes of these layers are influenced by the intensity of the ionization, which in turn depends upon many things. The major factor affecting the ionosphere is solar activity. During years of high activity on

the part of the sun (sunspot maxima), ionization is more intense and the maximum usable frequencies are higher, than in years of low solar activity. The seasonal variation between winter and summer performance is due to the change in the angle at which solar radiation reaches the earth, which affects the height of the layers. For serious DXers, intense study of the ionosphere is indicated.

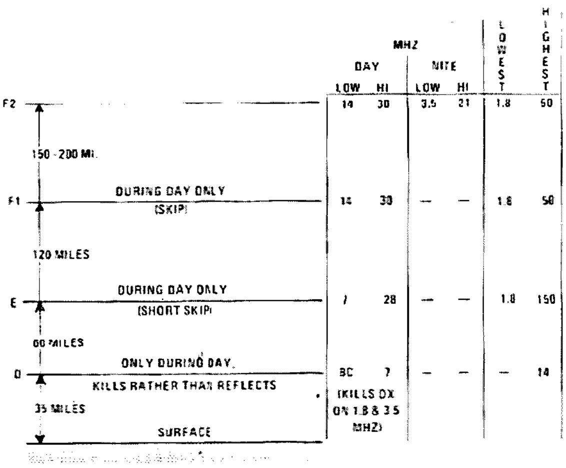

Fig. 12-4. Various layers of ionosphere and their characteristics are shown here. Both the upper and lower frequency limits for each layer, day and night, are listed. Seasonal variations also occur, and entire range is shifted by the 11-year sunspot cycle. These variations are shown as "lowest" and "highest" columns in listing.

Because of all the variable factors affecting the ionosphere and thus changing the way in which signals are reflected, any generalizations about the various ham bands' typical characteristics must be subject to rather large amounts of error. The following summary is intended to portray "typical" conditions which, unfortunately, are hardly ever met in actual practice.

The lowest frequency ham band, 160 meters, has only limited usefulness for any purpose during daylight because of the strong absorption by the D layer. Even at night when the D layer is no longer present, range of "top band" operations is limited, but transoceanic DX has been achieved and many operators take a special interest in activity on this band, traditionally the oldest of them all (because original ham activity was restricted to shortwaves, and these wavelengths are the longest of the original ham region).

The next higher ham band, from 3.5 to 4.0 MHz, is known as 80 meters to CW and novice operators and as 75 meters to phone enthusiasts. It is one of the most popular bands for domestic activity. During the day its range is restricted by D-layer absorption, but this restriction usually vanishes near sunset and the band then opens up to permit transcontinental contacts, with little or no "dead zone" between. It could easily be possible to assemble a roundtable network on 75 or 80 meters with stations from every one of the 48 contiguous states, with every station hearing each of the others, were it not for the congestion due to the band's popularity.

Above 75 meters, the next ham band is 40 meters. This band sometimes suffers from D-layer range restrictions during daylight, but even during the day ranges up to 1000 miles or so are not uncommon. The maximum usable frequency at any time is usually well above 7.3 MHz, so that 40-meter signals may reflect nearly vertically from the E and F layers to provide good coverage of extended areas. At night, the band may open up for intercontinental operation, and nationwide night coverage here is the rule rather than the exception.

The 20-meter band, from 14 to 14.3 MHz, is traditionally the DX band. It is seldom used for domestic purposes, other than coast-to-coast contacts via single-hop F2 skip, but provides worldwide coverage capability day or night. Sometimes the maximum usable frequency (MUF) drops too low at night to permit use of 20 meters, but this occurs only near the periods of minimum solar activity. At most times, this band is always open to somewhere far away.

On 15 meters, DX is also the normal condition,but by this time we are into the upper frequency region (above 21 MHz) where sky-wave operation is not always possible. When the ionosphere will not reflect 15-meter signals, this band is virtually dead. On the other hand, when the band is open it frequently offers a longer operating range (more distant DX) than does 20.

The 10-meter band, from 28 to 29.7 MHz, is like 15 only more so. During sunspot maxima, the band is often open round the clock, and intercontinental contacts are there for the working. For a large part of the time, though, the band is dead and is used only for local mobile operation such as is found in the VHF region.

The 10-meter band is the upper limit of HF ham bands; the boundary between HF and VHF lies at 30 MHz. The lowest VHF ham band is 6 meters (50–54 MHz), just below TV channel 2 in the spectrum. This band is an experimenter's delight, because unusual propagation techniques such as scatter, tropo propagation, etc. become easy to handle at this frequency. Normal sky-wave operation so common to "dc bands" (the VHF operators' derisive label for the HF region) is rare on 6 meters; sporadic-E brings 1500-mile ranges occasionally, and about one year out of eleven at sunspot maximum the F2 reflecting capability may climb up to the lower part of this band, but for the rest of the time most use of this band is for local communication and mobile operators.

The 2-meter band is like 6 only more so, somewhat as 10-meter operation resembles that on 15. Sky-wave propagation is almost unknown at 2 meters and above, but the exotic propagation techniques such as meteor trail reflection, moonbounce, and satellite relay begin to become practical. The dedicated 2-meter operator usually concentrates on this type of operation, while the casual user and the public-service-oriented operator make use of mobile installations and FM repeaters.

The uppermost VHF ham band is 220 MHz or 1¼ meters. Its characteristics are very similar to those of 2 meters, but because of the increased difficulty in making circuits operate easily this band is not so popular with most operators. It may be lost ere long because of its relative unpopularity, as was the old 11-meter band.

What Are Some of the Rules?

The final authority concerning what a licensed ham may and may not do with his station is Part 97, FCC Rules and Regula-

tions, published by the Government Printing Office and available from the Superintendent of Documents. Every ham or would-be ham should have an up-to-date copy, but the sad fact is that few really do.

The pertinent portions of Part 97 are published as a part of the ARRL's license manual, and since the license manual costs only a fraction of what the real rule-book will set you back, most hams simply keep a relatively recent copy of this around to satisfy the requirement that they must know enough about the rules to follow them at all times.

The rules themselves divide into several categories. Some govern the physical characteristics of an amateur station; this is particularly directed at antenna height, and the idea is to be certain that no ham antenna is high enough to be a menace to airplanes. At this writing, the limit was 170 ft, or 1 ft above ground for every 200 ft range from an airport, whichever is less. Exceptions may be granted upon written application, which means in effect that if it's all right with the FAA, it suits the FCC also. Also in this group are the rules which require every amateur station to have a "fixed" transmitter location, which means a mailing address at which the licensee can always be reached.

Another group of regulations within Part 97 establishes technical standards for amateur stations. These rules establish the authorized frequencies for each class of licenses, the power limits, the type of signals permitted, and the quality of signals required.

A third category of the rules sets up operating requirements and practices required of all licensees. One key point which the FCC has always felt it necessary to explicitly state, and which many hams often violate, is that in all situations not specifically covered by these regulations, each amateur station shall be operated "in accordance with good engineering and good amateur practice."

Among the rules in this category are those requiring a licensed amateur to control the station at all times when it is operating, prescribing the method for identifying the stations in a conversation, permitting certain kinds of one-way transmissions, and detailing procedures for portable and mobile operation. Log-keeping and emergency operation are also covered in this section, as are "permissible communications."

Not all the "permissible communications" rules binding the U.S. ham are listed in Part 97, however. International regulations also apply, and these international regulations restrict the kind of communication permissible between two amateur stations to "messages of a technical nature relating to tests" being carried out, and "remarks of a personal character for which, by reason of their unimportance, recourse to the public" communication services is not justified. They continue to spell out that it is "absolutely forbidden" for amateur stations to be used for transmitting international communications on behalf of "third parties" (meaning someone other than the two hams involved in the contact). The term "third party traffic" has come to signify this "absolutely forbidden" type of message.

What makes third party traffic legal at all is the fact that it is not forbidden in domestic communication, only internationally; and even in international situations, the prohibition "may be modified by special arrangements between the administrations of the countries concerned." The United States has made such special arrangements with a number of countries. The exact list of nations with which third-party traffic is legal varies from time to time, and may be obtained directly from the FCC.

The same international agreement also makes it illegal for hams of one country to contact those in any country which has filed formal objection to such international contacts. Several countries are currently on the forbidden list. Again, contact the FCC for the up-to-date listing.

Back to Part 97, a fourth category of FCC rules specifies "prohibited practices and administrative sanctions." Prohibited practices include broadcasting, accepting any form of compensation for use of a ham station, transmitting music or secret codes, use of "obscene, indecent, or profane"

language or expressions on the air (which, like many present laws in this area, may not be enforceable, and which the FCC has indicated it will not enforce in all cases), transmitting false or unidentified signals, willful or malicious interference with any radio communications or signal (whether a legal signal or not), assisting anyone to obtain a license by fraud, and willful damage to any radio apparatus. If you get mad at your equipment, don't smash it.

Administrative sanctions include "quiet hours" or restricted operation, in case a specific ham is causing interference to other services. Several levels of restricted operation are prescribed; the most restrictive permits the ham to operate only between the hours of midnight and 8 a.m.

A fifth category of rules sets up the Radio Amateur Civil Emergency Service and governs its operation, while a sixth category prescribes requirements for ham station operation in this country by aliens who are licensed in their own countries. Only the first four categories are likely to be covered in detail on the General class exam.

Because the exact provisions of the rules are subject to change much more frequently than are the technical matters which we have been discussing in most of this course, we won't attempt to go into more detail concerning the rules. We recommend that you obtain a copy of Part 97 shortly before taking the exam, and studying the four categories of rules we've discussed here. Particular points to note are the frequency limits for the various classes of license and types of emissions, the corresponding power limits, and the section dealing with technical standards.

What Can Be Done About TVI?

Of all the "alphabet soup" combinations of initials which have hovered around our culture for the past 40 years or so, probably none has caused so much agony to so many hams as TVI.

Those three letters stand for television interference – specifically the type resulting from ham operation. In the early days of TV, TVI was the rule rather than

Inexpensive Cable Lacing Twine

A suitable and inexpensive substitute for linen cable lacing twine is available in small quantities at your local drug or variety store. It is not only excellent for the job, it is convenient too, most brands come in a handy dispenser with an integral blade for cutting off the required length. The 100 yard size costs very little and will last through countless projects. What is it? Simple–dental floss.

William Turner WAØABI

the exception for an amateur station, and many hams simply shut down their operations for considerable periods of time until they learned how to overcome the problem.

They had good reason to do so, too. A woman scorned *may* equal the fury of a televiewer whose picture is suffering interference, but it would be difficult to convince those hardy hams who have faced both furies that the one resulting from TVI wasn't the worst of the pair.

History is full of instances of antennas being cut down, tires being slashed, antenna towers toppled, and hams being threatened with assault (and worse) because of TVI.

One factor which made the problem so difficult in the early days was that almost all early TV receivers used an i-f of 21 MHz, smack in the middle of one ham band, at the third harmonic of another, and the sixth harmonic of still a third band. In addition, the 6-meter ham band and TV channel 2 are adjacent to each other. No matter what band a ham used, he could hardly help getting into one of those old TV receivers. If he didn't make it in through the tuner, he would come in through the i-f section. On the rare occasions that both these failed, the audio sections would pick up his energy and detect it, and there he would be in the sound channel.

For several years, it seemed almost as if TV designers went out of their way to create the probability of ham interference. One ham thought he had escaped from TVI when he abandoned his favorite HF bands and went to 2 meters for all operation. He reasoned, correctly, that at this high frequency he couldn't possibly transmit any harmonics which could get into either the front end or the i-f of a TV receiver, and since he was an apartment dweller surrounded by televiewers this was important.

He learned, rapidly and to his utter dismay, that most of the TV sets in his apartment building were of a specific make and model which had the volume control on the front panel, and the audio section at the rear of the chassis, with a pair of 19 in. wires connecting the volume control to the audio section. As it happens, 19 in. is a quarterwavelength at 144 MHz; almost every one of his neighbors' TV sets had a very good quarter-wave whip antenna sucking in his 2-meter signal and spewing it into the audio section!

From experiences such as these, the subject of TVI gathered about itself a mystique and books full of exotic cures. One, for instance, which would cure such cases as the 19 in. leads (if you could convince the televiewer to do it), was to wrap the TV set completely in aluminum foil, and bond the foil to a water pipe. This made it a bit difficult to see the picture, but they solved that by putting screen wire over the picture tube face. Naturally enough, this approach did not prove popular with the public. They had spent much money for those sets, and obviously it had to be the hams who were at fault.

Not all the complaints were so serious, though. Occasionally a viewer would call a ham to mention that he was hearing the ham's side of the conversation, and far from complaining, was interested enough to want to hear the rest of the conversation as well. This offered a source of new converts to ham radio – and it was sorely needed in those trying times.

Along the way, of course, those hams who stuck to it managed to learn how to clean up their transmitters and receivers (yes, even receivers created TVI) so that the only troubles left were due to faults in the TV sets themselves (and in the whole nature of radio – a class of problem exists which just happens, and we'll get to it shortly). These lessons were passed on through the ham magazines and by discussions, reaching the designers of commercial ham equipment, and the status of being "TVI-proofed" rapidly became a key sales feature for a commercial rig.

What really made the problem manageable, though, was the TV industry's realization (with a bit of government prodding) that it wasn't really good engineering to select ham bands for the i-f, and the subsequent switch to 41 MHz as a standard i-f for TV receivers. Once the obsolete sets with 21 MHz i-f strips became extinct, the number of TVI complaints dropped notice-

ably. And the existence of TVI became a sales pitch for pushing those new TV designs as well.

Nevertheless, the problem is still with us (although at reduced magnitude), and probably always will be. So, for that matter, is the inverse problem – interference to ham stations by TV receivers. The 15–750 kHz horizontal sweep frequency of a TV set is rich in harmonics, and on occasion makes the lower frequency ham bands unusable. Here, however, we'll concentrate on TVI rather than ITV (interference by television).

A TVI problem normally will fall into one of three categories. Either the ham station is at fault, the TV receiver is to blame, or it's the result of a law of nature about which no one can do anything.

Faults at the ham station usually boil down to the fact that the transmitter is letting unwanted harmonic energy get out, and some of this energy falls within the TV channel someone wants to watch.

The cure for this class of problem is to prevent the transmitter from letting the unwanted harmonics out. Careful tuning and operation can reduce the amount of harmonic energy generated, but a certain unavoidable percentage of harmonics are inevitable when class c amplifiers are used. A single-band antenna rather than a multiband design can help prevent the radiation of harmonics, but the accepted cure for the problem is installation of a low-pass or "TVI" filter in the feedline between transmitter and antenna. This filter will have little effect upon normal transmitter operation, assuming that the feedline is matched so that the filter sees its design impedance levels at input and output, but will block the path for the higher frequency interference-creating harmonics. Figure 12-5 shows the hookup.

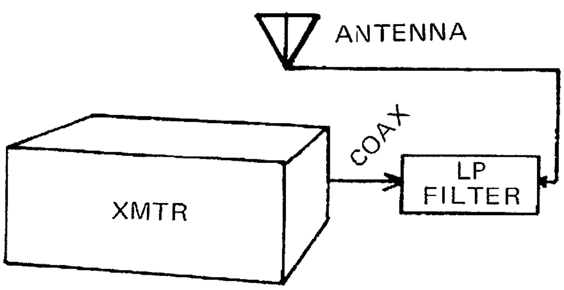

Fig. 12-5. Low-pass filter connected between transmitter and antenna as shown will help control TVI if harmonics are getting out through feedline. For this to be effective, transmitter itself must be properly shielded and all power and control leads filtered, so that no harmonic energy can escape except through the feedline. Antenna tuner serves just as well as does special TVI filter, and also permits accurate matching to antenna.

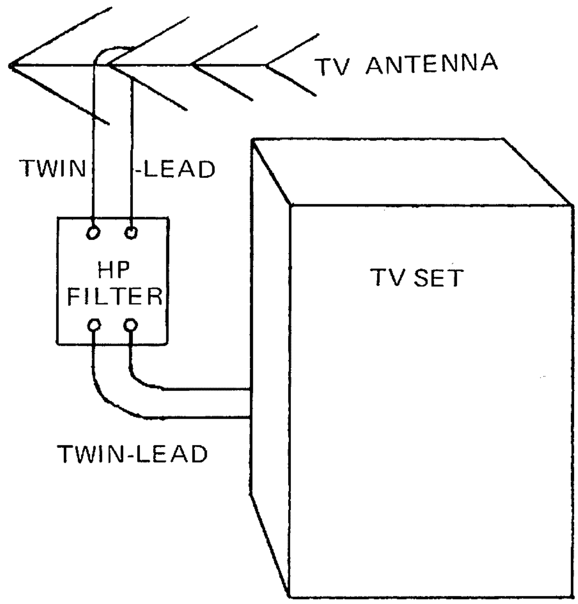

Fig. 12-6. When ham station is operating properly and TVI is due to TV set's failure to reject ham signals, a high-pass or TVI filter between the TV antenna and TV receiver as shown here may prove helpful. Most TV manufacturers will provide such filters free of charge upon request by the TV set owner, in compliance with FCC requirements that sets not be capable of radiating energy (the filters serve to prevent radiation of signals from the set, as well as reception of undesired signals by the set).

Faults at the TV receiver may be insufficient selectivity, which permits the ham signal to get into the receiver front end despite the wide difference in frequency and thus overload the set, or inadequate shielding, which may lead to the audio pickup problem mentioned earlier.

If the trouble is due to the ham signal getting in through the front end, a high-pass filter in the feedline may help. This won't affect the high-frequency TV signal but will cut back on the amount of ham signal which gets through. Figure 12-6 shows how such a filter is installed. In

weak-signal areas, it may be possible to readjust the TV antenna to put the ham station's signal in a null without significantly reducing the signal from the TV station, also.

If audio pickup is creating the problem, the surgery indicated by Fig. 12-7 is an almost-guaranteed cure. This may be applied to any kind of audio equipment which is bothered by ham interference, such as BC radios, record players, tape units, and so forth. It simply prevents the ham signal from being detected by the audio stage, without harming the normal function of the audio stage.

The most difficult class of problem to deal with is that which is nobody's fault. The most common such problem is one in which two radio signals, each faultless in itself, mix in some accidental circuit (such as a corroded rain gutter or a rusty metal fence) to create either a sum or a difference product which comes out in a valid TV channel and causes interference. Sometimes one of the original signals is itself a TV signal.

For instance, if a city has stations on channels 4 and 13, it's easy for a ham operating on 144 MHz or a frequency close to 144 to create interference through no fault of his own. This comes about because TV channels 4 and 13 are exactly 144 MHz apart, and the ham's 144 MHz signal can

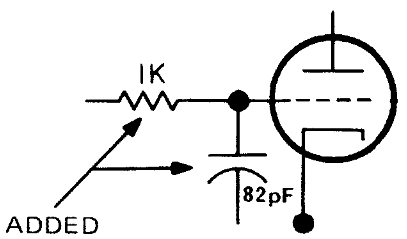

Fig. 12-7. Most cases of audio interference to TV by hams involve detection of the ham signal by the audio circuits of the receiver. This type of interference can also attack hi-fi installations, BC radios, and other entertainment devices. It is almost always due to faulty design of the affected device. Addition of an rf filter composed of a resistor and capacitor as shown here will cure it. Never make the change yourself, though; insist that the work be done by a professional service technician unless you want to be blamed for everything that ever may go wrong with the set after the filter is installed.

mix with the channel 4 signal to produce interference on 13, and at the same time mix with the channel 13 signal to produce interference on 4. While all this is going on, the two TV signals are mixing and wiping out the ham's receiver on 144 MHz.

When this happens, you can do only one thing: find a new operating frequency which does not cause interference. There are just too many possible sources of mixing action to hope to track them all down, and even if you could, new ones would develop naturally within a few days.

Most cases of TVI, however, do not involve this kind of mixing. The majority result from improperly operated ham transmitters, and misused TV receivers. Usually, tact and diplomacy rather than technical knowledge are the cure to the complaint, but it always helps to be able to show your own TV sitting alongside your station, operating perfectly, to convince the complainer that you aren't deliberately upsetting his reception and that possibly his own set may be contributing to the problem.

How Can Hams Improve Their Bands?

Interference and congestion are the hallmarks of the amateur bands, which has suffered an overpopulation problem since long before the population explosion became a popular worry.

The cause of the problem is painfully obvious: Several tens of thousands of hams over the world, at any one instant, are attempting to all operate in a segment of the rf spectrum which totals less than 4 MHz, and which furthermore is split up into many smaller sections.

Not all of these small sections are overpopulated. For instance, while the 75-meter phone band may be a mass of interference from one end to the other on a winter weekend night, it's quite likely that the CW portion of 80 meters may be almost vacant at the same time.

Similarly, the low end or "rare DX" region of the 20-meter CW subband may be a howling cacaphony of QRM, while only a few dozen kilohertz away from the pileup, vacant space goes begging.

One cure for congestion would be unpopular, but has been seriously suggested by some hams – that is, to limit the amateur population. This may, in fact, have been partially behind the incentive-licensing proposals which raised such a furor in ham ranks. It's certain that at least some hams quit in disgust over the issue, but it's doubtful that the net ham population suffered any loss because of continual infusions of new amateurs.

Short of an actual restriction upon numbers of hams, about the only practical solution to the problem is for all operators to adopt procedures which tend to minimize congestion and interference.

Among these procedures are the elimination of unnecessary on-the-air testing, keeping contacts on crowded bands brief, and listening more than you transmit.

Some on-the-air testing is, of course, necessary. You can't tell how a new antenna is going to load without loading it, for instance, and it's difficult to check the efficiency of a TVI-proofing operation unless you put the transmitter on the air and see whether its TVI is eliminated.

But there's no need to perform such tests as these at the times when the band is most crowded. Most on-the-air testing is of a nature which can be done almost any time, and if it's done when the band is relatively unused it obviously won't interfere with as many communications as it would if performed when the band was at its most crowded level.

Along with unnecessary on-the-air tests during crowded operating hours, long-winded CQs can be done away with. Inexperienced operators in particular tend to call CQ for hours on end, without stopping to find out if anyone is answering. While there's no officially recognized record, the fellow who sent nothing but "CQ" for 15 minutes without a break undoubtedly was a contender for it – not to mention being a rule violator, because the rules require that the transmitting station be identified at least once every 10 minutes.

Normally, a "3 by 3" CQ is adequate for the purpose. A "3 by 3" from W2NSD/1, for instance, would be: "CQ CQ

CQ de W2NSD/1, CQ CQ CQ de W2NSD/1, CQ CQ CQ de W2NSD/1." Then pause and tune the band to see if anyone is answering. Since an answer may show up anywhere on the band, it will take much longer to tune for a possible reply than it took to send the call, and so the transmitting/receiving time ratio will go down for each operator – which reduces band congestion..

Keeping contacts brief is a rule of life for DX operators, who are trying to make as many contacts as possible in a limited time. Even for a ragchewer who enjoys conversation for its quality rather than its quantity, though, there's no need to spend all night saying "uhhhh . . . " into the mike. During contests or other periods of high activity, when bands are at their most crowded, the ragchewer might do well to avoid the crowded parts of the bands and wait until later to visit. This will preserve not only the tempers of the other operators, but that of the ragchewer as well, because he won't be continually plagued with interference drowning out part of his contact.

This is not an argument against chewing the rag, because that can be one of the most satisfying aspects of ham radio for those who enjoy conversation. It's merely recognition that there's a time and a place for everything, and a crowded expressway is no place to pull up alongside an old friend, stop, and visit. When expressway conditions prevail on the bands, visiting can move to less crowded regions, and return when the traffic is less dense.

Technically adequate equipment, operated properly, is necessary to reduce congestion. An overmodulated phone rig, whether AM, FM, or SSB, can interfere with every contact on an entire band. This, however, is not so much an operating practice as it is a question of meeting the required technical standards (most of which are intended to reduce interference to a minimum).

Proper choice of the type of modulation to suit the purpose of the contact can go a long way toward reducing interference. A CW signal takes up only about 1/600 the bandwidth of an AM phone signal, so for contacts which can be adequately handled by CW, it would be the proper choice from an interference standpoint. RTTY compares favorably to CW in its bandwidth requirement.

Another operating practice which reduces congestion is that of adopting operating standards, then adhering to them. For instance, on a traffic net many operating conventions are established in order to minimize the number of times a message (or part of a message) must be repeated. When the same message is going to several addressees, the text may be sent only once. Conventions of this sort help reduce the amount of time any one station is on the air, which in turn reduces congestion and interference.

Interference can be minimized by "channelizing" operation, and there has been some movement towards doing so on a voluntary basis on some bands. This means that an operator on such a band uses only one of the "channel" frequencies, rather than using a frequency between channels. When the channel frequencies are properly chosen to suit the type of modulation in use, no transmission on any channel will interfere with any signal on any other channel. The only interference then comes from other stations on the same channel, and from those individualists who persist in using the spots between channels. The fellows "in the cracks," however, interfere with not one but two channels, and receive interference from both as well, which tends to discourage them from staying there.

The most important single rule to reduce interference and congestion, though, is one which is not limited to radio. It was enunciated many years before radio was invented, and reads: *Do unto others as you would be done unto.* Any operator who follows this rule, in all cases, should find few problems with interference – and if we all followed it, the interference and congestion problems which have plagued ham bands from the beginning would disappear.

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EFFECTIVE HEATSINKING FOR SUCCESSFUL SOLID-STATE DESIGN

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Why does a 100W transistor "blow" when dissipating only 25W? How much heatsink is required for a particular application? Questions like these stop most hams dead in their tracks. The purpose of this article is to give some insight into the thermal considerations of transistors.

The critical thing regarding power dissipation in transistors is the temperature of the collector-base junction. All transistors have a maximum allowable junction temperature, usually in the range of 85–100 °C for germanium units and 175–200 °C for silicon. The operating junction temperature is determined by the ambient temperature, the thermal resistance from the junction to the ambient, and the power the junction is dissipating, or converting to heat. The entire thermal situation is most easily understood by use of an analagous electrical circuit. The thermal parameters and their electrical equivalents are shown in Table I. The circuit is shown in Fig. 1.

Table I. Thermal and Electrical Equivalents

ELECTRICAL PARAMETER	UNITS	THERMAL PARAMETER	UNITS
voltage (E)	volts (V)	temperature (T)	degrees (C)
current (I)	amps (A)	power (P)	watts (W)
resistance (R)	ohms (Ω)	thermal resistance θ	degrees·C watt (C/W)

A current source represents the power being dissipated by the transistor and a battery represents the ambient temperature. The thermal resistance from junction to ambient is shown as three resistors in series; the junction-to-case resistance θ_{JC}, the case-to-heatsink resistance θ_{CS}, and the heatsink-to-ambient-resistance θ_{CA}. The voltages at the various circuit nodes represent the ambient temperature T_A, the heatsink temperature T_S, the transistor case temperature T_C, and the junction temperature T_J. The junction temperature is the product of the power and total thermal resistance plus the ambient temperature.

$$T_J = P \times (\theta_{JC} + \theta_{CS} + \theta_{SA}) + T_A$$

Thus, the maximum allowable power dissipation is:

$$P_{MAX} = \frac{T_{JMAX} - T_A}{\theta_{JC} + \theta_{CS} + \theta_{SA}}$$

In the case of transistors operated without a heatsink the three resistors may be lumped into one, θ_{JA}, the thermal resistance from junction to ambient. Then the equations become:

$$T_J = P \times \theta_{JA} + T_A$$

$$P_{MAX} = \frac{T_{JMAX} - T_A}{\theta_{JA}}$$

At this point it becomes obvious that the power rating of a transistor is a function of ambient temperature. The hotter the transistor's environment, the less power it can handle, because the junction must be kept below a certain temperature. Transistor power ratings are generally given for a case temperature of 25 °C (normal room temperature). Thus, a 100W transistor can handle 100W only if the case temperature is held to a maximum of 25 °C. Referring to Fig. 1 we see that in order to accomplish this with an ambient temperature of 25 °C would require a thermal resistance from case to ambient of zero, in other words an infinitely large heatsink bonded perfectly to the transistor's case! If the total thermal resistance from junction to ambient was, say, 10 °C/W, the ambient temperature was 25 °C, and the transistor was dissipating 25W, the junction temperature would be:

$$T_J = 25\ ^\circ C + 25W \times 10\ ^\circ C/W$$

$$= 25\ ^\circ C + 250\ ^\circ C = 275\ ^\circ C$$

more than enough to blow any transistor!

So now we know why a 100W transistor can blow when dissipating only 25W. The next question is how do we find the values for the various thermal resistances and the maximum junction temperature so that we can calculate a more usable power rating.

Determining θ_{JC} and T_{JMAX} is easy, especially if you have a spec sheet for the transistor in question. The thermal resistance from junction to case may be given directly or as a derating factor of so many watts per °C of case temperature above 25 °C. These two figures are reciprocals – that is, dividing either of them into the number

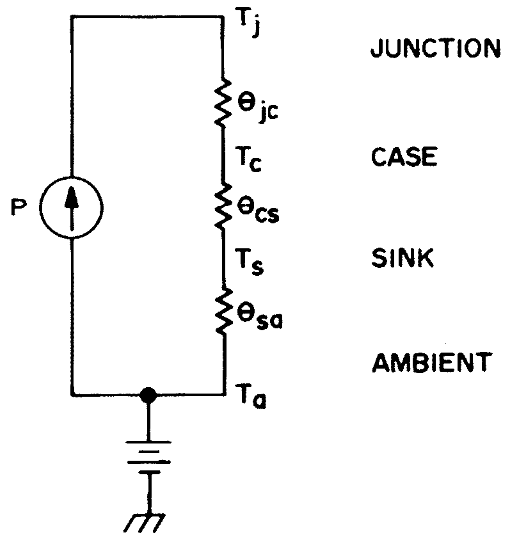

Fig. 1. Electrical circuit equivalent of heat dissipation problem.

one gives the other. Thus, a derating factor of 0.5 W/°C implies a θ_{JC} of 2 °C/W. Maximum junction temperature may be given directly or as a maximum storage tempeature. That these two numbers are equal may be seen by considering Fig. 1 with zero power. Even if you only know that you have a bargain basement "200W germanium power transistor" you can still come up with reasonably accurate results by assuming a conservative T_{JMAX} and using the equation

$$\theta_{JC} = \frac{T_{JMAX} - 25}{P}$$

For germanium transistor assume T_{JMAX} is 85 °C, giving;

$$\theta_{JC} = \frac{85 - 25}{P} = \frac{60}{P}\ ^\circ C/W$$

For silicon, use 150 for T_{JMAX}, giving;

$$\theta_{JC} = \frac{150 - 25}{P} = \frac{125}{P}\ ^\circ C/W$$

With this information we can calculate maximum allowable power dissipation for any given case temperature. Now we need to consider the thermal path from the transistor's case to the ambient air.

Referring to Fig. 1 we see that the path from case to ambient consists of θ_{CS} and θ_{SA}. The first term, θ_{CS}, depends on how well the sink is thermally coupled to the transistor's case. Typical values range from 1.5 to 0.1 °C/W, the higher value being for a "dry" mounting with a Teflon insulator and the lower value for a mounting with

silicone grease and no insulator. The second term, θ_{SA}, is a function of the size and geometry of the heatsink. Here again, values may be obtained from manufacturer's specifications, and range from around 60 °C/W for clip-type radiators for TO-5 packages to 0.5 °C/W for 100 cu in. heatsinks for power transistors. A 10 in. plate of 3/32 aluminum has a thermal resistance of about 5.5 °C/W, while increasing the size to 80 sq in. reduces the value to about 2 °C/W. When no heatsink is used θ_{CS} and θ_{SA} combine to a single thermal resistance θ_{CA} which depends on the geometry of the case and is typically 150 °C/W for TO-5 packages and 35 °C/W for TO-3 packages.

At this point the whole subject may appear rather complicated! However, the basics are really quite simple once the circuit of Fig. 1 is understood. At any given ambient temperature the power handling capability of a transistor is determined by four factors; the maximum allowable junction temperature and three thermal resistances, one associated with the transistor's internal construction, one associated with the mounting hardware, and one associated with the heatsink. On some spec sheets one of the resistances may be ignored, assumed to be zero, or combined with one or both of the other two. In general, however, all three must be accounted for.

The biggest problem for the average ham is determining the effectiveness of homemade heatsinks. This is very easy to do *if you have a way to measure the transistor's case temperature.* This measurement may be made with any one of a number of instruments or chemical preparations, none of which is likely to be found in the hamshack. This "if" depends pretty much on who you know and what you can borrow. Assuming you can manage to get your hands on some such device, θ_{CA} may be determined by dividing the difference in case temperature and ambient temperature, in °C, by the power being dissipated by the transistor.

$$\theta_{CA} = \frac{T_C - T_A}{P}$$

K5ZBA■

The Spider

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Anyone faced with the prospect of connecting a transceiver to a high-power final amplifier encounters interconnection problems. The Spider, an rf-actuated antenna relay, solves these difficulties.

The device performs three simultaneous functions: It switches the antenna from the transceiver output to the final amplifier output, switches the transceiver from the antenna to the grid of the final amplifier, and closes a set of auxiliary control contacts for any other exterior function.

Most transceiver owners are reluctant to dig into the control circuits of their equipment to bring out connections which can control an external power amplifier. To simplify the control considerations this device is designed to trigger on the rf output of the transceiver. Switching is accomplished by a direct-coupled transistor amplifier. A small capacitor couples rf into the amplifier at the moment the transceiver is energized, closing the relay. Whe the transceiver goes into receive mode the relay drops out, switching the system back to straight-through operation.

The "spider" pictured here was designed primarily for 2m operation, specifically to interconnect a 10W FM transceiver and a 300W power amplifier. The coupling capacitor which feeds rf into the transistorized relay amplifier has a value of 3 pF.

If lower frequency is desired it may be

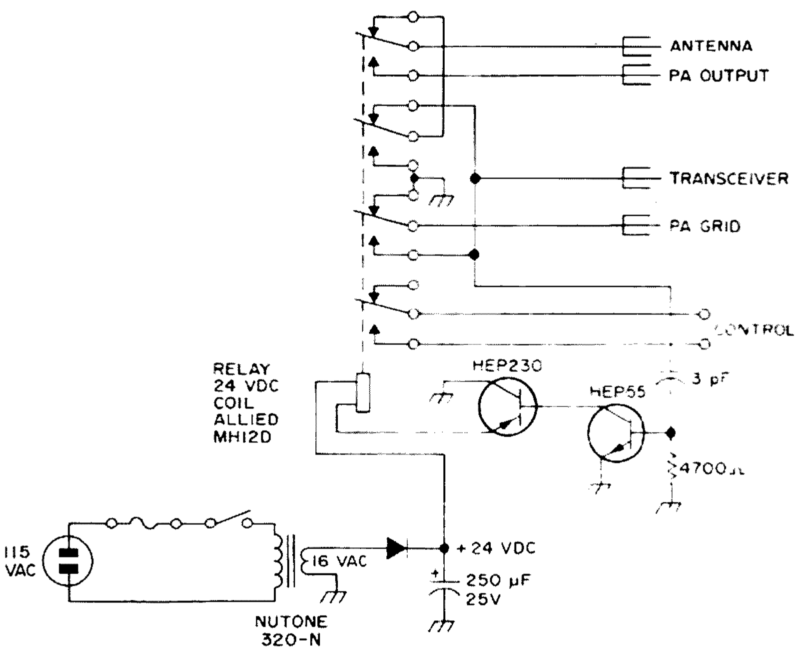


Fig. 1. Circuit diagram for the Spider.

necessary to use a larger value capacitor. To prevent overloading of the input transistor the smallest value possible should be used.

The relay is powered by a 24V supply. The transformer is available at hardware and electrical supply stores. Since it was intended for chimes and doorbells it may be left connected to the line on standby for an indefinite period.

The relay drive is a HEP 230 PNP power transistor and the input transistor is a low power HPH (HEP 55). The power transistor has its collector connected to ground so it may be bolted directly to the chassis.

The heart of the device is a 4 PDT relay with a 24V coil which may be selected to suit the convenience and pocketbook of the builder. Most surplus 24V aircraft relays pull in at 75–200 mA of current, which is within the ratings of the driver transistor The relay should be selected by the builder not only for the proper coil current, but for a contact arrangement which will not introduce too much unwanted inductance into the antenna circuit.

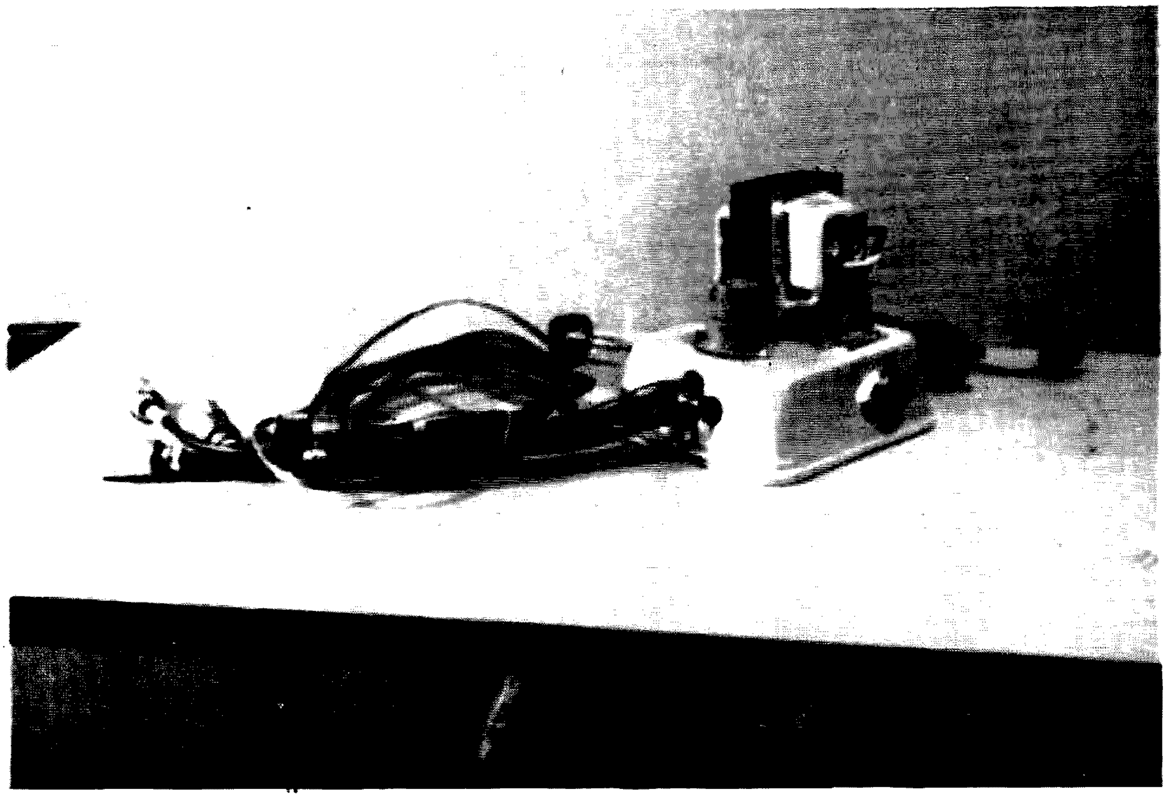
The relay chosen for my unit was selected for 2m operation. It is a sealed aircraft unit with contacts mounted on the headers spaced in a circle around the armature. Rf characteristics are good since contact length is short and a rotary action of the armature closes the contacts.

Four lengths of RG-58/U, each 20 in. long, are fitted with PL-259 connectors and the other ends brought into the chassis to the base of the relay. The braids are grounded to a U-shaped loop of 18-gage wire which is grounded on each side of the relay. Each cable should then be marked to identify its function.

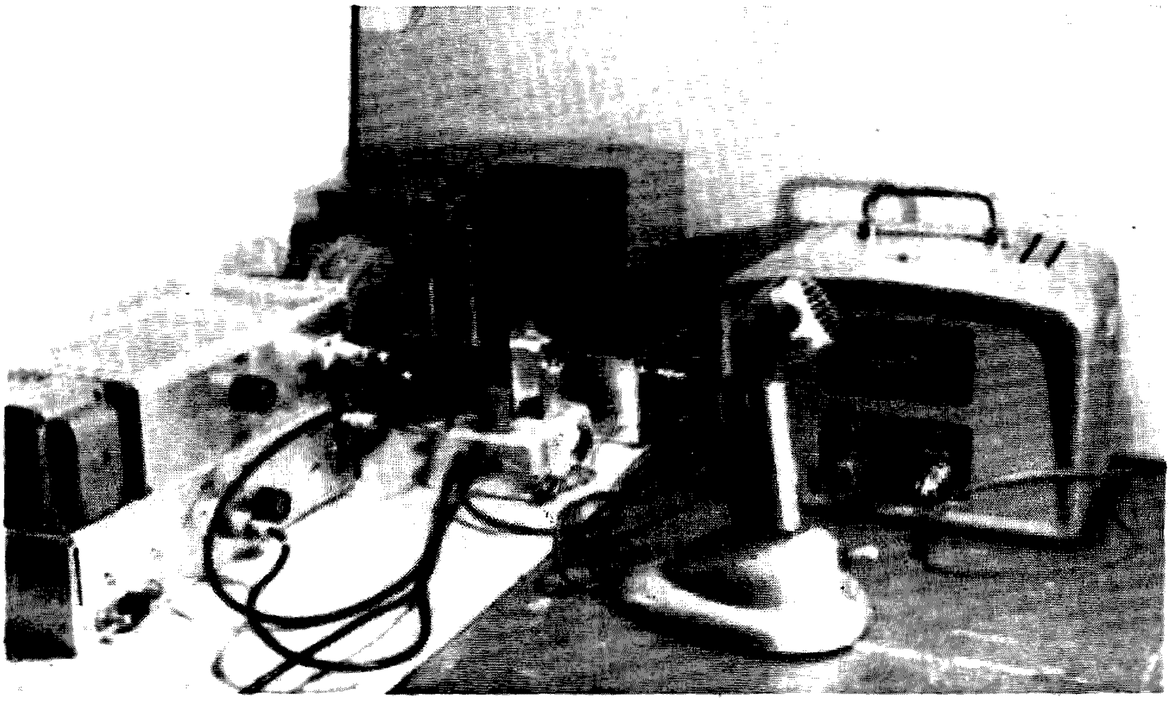
The entire assembly was made on an aluminum freezer tray which is small enough to be tucked away into any convenient space betweeen equipment.

In operation the cables are connected but the final amplifier power supply is not turned on. When the transceiver is energized, a click should be heard in the relay, indicating that rf is triggering the relay drive properly. If the control contacts are then connected to the final amplifier power supply the device will activate the final at the same time switching is accomplished.

Note that rf does not flow in the



The completed Spider.



Spider connected to transceiver, power amplifier, and antenna. Auxiliary contacts on Spider key on power supply at rear.

contacts until after they are completely closed because of the slight time delay while the final amplifier power supply comes on. When dropping back to the receive mode, rf is removed before the contacts open. This design eliminates arcing and adds to the life of the relay contacts. To state it more simply, on transmit the rf precedes the plate current and on receive the rf goes off before the plate current.

In order to allow straight-through operation of the transceiver a power switch is provided on the chassis to turn off the 24V power supply. With the relay off, the transceiver works straight through to the antenna and the final amplifier power supply is not energized.

. . .W4RIZ■

Band Monitor For SB-300

Have you ever lost a call because you got tired of winding that band-switch back and forth across the band? Especially on the SB-300, where that great bandspread is something else again when it comes to finger fatigue after a few trips across that mammoth band. Here is a little modification that may prove helpful for listening for calls for which you perhaps know the approximate frequency, like tuning around for a net that may start any time, or listening for a ham friend who doesn't have the frequency accuracy you do.

This unit is most useful on the 6-meter band where the signals are (with converter) few and far between, and the one signal which will activate this device is most likely the one you want. It is also useful on the 80-meter band in the daytime for listening to that local who may call you anytime between 12:00 and 3:00 p.m.

The bandwidth of the SB-300 without the filters is about 130 kHz. Simply connect a high impedance monitor to the input to the crystal filters and use any type of indicating device you like, be it a light or bell.

The circuit should consist of a *rf* choke, a diode and an amplifier to operate a relay.

Anyone calling CQ, or your call, within 130 kHz of the setting you are on will activate your monitor. Then you must tune the band to find the absolute frequency of the calling station. Especially on the 6-meter band, if you have the converter, you can monitor the band all day, or at least 130 kHz of it, (and you probably know the normally used frequencies in your district) without that dreadful tuning.

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"SAY COO, SAY COO DAY ECKEES"

OR SOME HAMS DON'T SPEAK ENGLISH

All Americans know that everyone in the world can speak English, or at least that's the way we act. Actually, English is the native language for less than 10% of Earth's people, and one expert has said that 2,795 other languages are currently used even in this day of vanishing cultural and language differences. Of course, English is a world language and is known and used to a greater or lesser extent as a second language by several million people in addition to those who claim it as their mother tongue. Furthermore, it is the *lingua franca* of many international activities including ham radio, but American hams are missing some great experiences by having to confine their DX QSOs to English.

DXing Without English

I grant that you can work 300 countries and use only English, but when the thrill of getting a 30-second contest-style DX contact begins to wane, you should consider the possibilities of ragchew-type DX QSOs with some of the countries that are easiest to work. We all remember unusual stories we have heard over the air. A VK telling you firsthand about the great rabbit fence across Australia or a Spaniard describing the castles in Castile makes for much more of an experience than the usual "UR 5 by 9 hr, bcnu" QSO. But when you start to ragchew with some foreign hams, you will find that their English which sounded so good while they were exchanging the usual QSO trivialities – QTH, signal reports, and handle – isn't adequate to carry on a conversation in depth. But see how the QSO will spring to life if you direct a few questions at them in their native language. You will soon discover that the castles of Spain sound even more romantic and exotic when described in Spanish. I remember several DX QSOs that had almost reached the 73 and BCNU stage when I switched to Spanish. Suddenly the operator on the other end came to life, warmth and excitement came into the QSO, and I had a memory to cherish.

How to Begin

All very well and good, you may say, but what can a ham do who doesn't know a foreign language?The answer is simple: learn one. Most Americans are convinced that learning another language is an impossibly difficult task, at least for Americans. It must be admitted that achieving the level of proficiency necessary to carry on a fluent, extemporaneous dialog on any subject in a second language is a challenging and lengthy task, but a much lower level of

proficiency is sufficient to open new vistas for you in ham radio, vistas that you didn't even know existed. Don't be overawed by the task. After all, taxi drivers, bellhops, and porters in Europe can often use two or three languages well enough for their purposes. You may say, recalling the D you got in high-school French, that you have no ability with languages, but you did learn to speak your mother tongue fluently and what you did once, you can do again. An expert linguist once told me that studies have shown that the only prerequisite necessary to learn a second language is the desire to do so, and that those persons wanting to learn a language can, and those not wanting to, don't. It's that simple.

How should one begin? The first step is to choose a language. Concentrate on one, at least until you are well established with it. What language should you pick? This choice is largely a personal one, but I will make some suggestions based on my experience. First, don't select a rare, exotic language unless you have special reasons for your choice. You will not have much opportunity to use Telugu or Lesghian on the ham bands. Of course, if you already know a rare language or if you have personal reasons for wanting to talk with hams from Wales or Burma, then Welsh or Burmese may be the language for you. But the languages that a U.S. ham is most likely to use are Spanish, German, Japanese, and French, in that order. So pick your language and plunge in.

How can you best start? It may be a matter of resurrecting a language you studied in high school or college. Typically, most of us don't study a language in school with any actual expectation of ever really being able to use it, and many American foreign language teachers unfortunately share this lack of expectation. Most American students seem convinced that textbook Spanish or German is only that, that it could never actually be used, but those words and phrases you may have learned and forgotten are real and real people use them and will understand them. If you have had a year or two of a language, you have already made a good start. The way the language should be pronounced will quickly come back to you, and you may even remember a few words. In any case, you have a good base on which you can build.

"On the average you will have to meet a new word 14 times before it is yours."

Several ways for learning a new language are open to the neophyte and to the person with some experience. For self-study there are foreign language records and tapes. These are particularly helpful in learning correct pronunciation by imitation. And you should not overlook books. Although they will help you only in a limited way with pronunciation and conversation, no better or faster method than reading exists for increasing your vocabulary and for learning how a language is actually used. At first, reading in a foreign language will be painfully slow and not much fun. Eventually, you will notice that you don't have to look up the meanings of so many words, and wonder of wonders, the day will come when you will find that you are no longer translating but reading directly with understanding in your new language.

Be sure to start your reading with simple material. Don't be discouraged if you have to look up the same word several times before its meaning sticks. On the average, you will have to meet a new word 14 times before it's really yours. Graded readers based on very restricted vocabulary lists are readily available at any college or large general bookstore, and are most helpful in the beginning stages.

You will be more motivated and make better progress if you don't rush into advanced material too soon. However, once your reading ability has progressed sufficiently, do your reading from materials dealing directly with subjects that you expect to discuss. If you want to be able to talk about electronics, don't spend your time reading books on deep-sea fishing; read electronics. Arrange with a ham in a country using your new language to send you some ham magazines and electronics books, and then read and reread them. The reading will become easier and easier. Presently you will find that your dictionary isn't being used much. You can now deduce the meaning of most new words from the context in which they are used.

Learning to Speak

Although learning to read can be done by yourself, it is difficult to learn to handle conversation in a new language without help from another person. There are several approaches you should consider. Night classes in the conversational aspects of the common foreign languages are available through many colleges and universities. Another approach is to find a native speaker of your new language who would be willing to assist you. Often older persons who have time on their hands are more than glad to help, and you don't have to be able to visit them for every session.

"Don't end up unknowingly imitating some dialectic form."

Telephones transmit other languages just as easily as they do English. One word of caution, however, don't end up unknowingly imitating some strongly dialectic form. There is an enormous difference, for example, between the German Schwabian dialect and standard German. You don't want to be disappointed by later learning that you have mastered some local dialect, something bearing the same sort of relation to your new language as Cockney does to standard English. If the person helping you has had a fair level of education in his native land, you are probably safe. But a little discreet investigation might enable you to avoid disappointment later.

On the Air

You need not wait until you have a high level of proficiency in your second language before trying it out on the air. If you are really timid about using it, CW is an easy way to begin. Call signs, RST reports, Q signals and the like will all be the same. In addition to these, all you will need is about a dozen previously prepared written sentences to make up the body of your QSO. If you can read your new language, you will have no trouble handling what your contact sends you. Have some questions ready to ask him, and hope that he doesn't ask you any, forcing you into making extemporaneous answers. But don't worry – he probably won't ask any questions. Most hams don't. So you probably won't have to improvise, but if you must, just do your best, and as a last resort you can lapse back into English. With a little experience your repertoire will grow, and you will begin to enjoy improvising answers and comments as you need them.

Now you are ready for phone. Instead of launching into a full-blown QSO, you will feel more at ease at first if you just use your new language for a few of the standard phrases used to close a QSO such as "Good luck, 73, I hope to talk with you again." Next, you might try a few sentences such as "I have studied a little Spanish and can speak it a little," or "I can read German, but cannot speak it very well." A sentence or two like that will usually result

in your contact giving a whole paragraph of your new language back to you on his next transmission. You may get more than you can handle, but if you have warned him that you can speak only a little of his language, he will usually come back speaking slowly. If you do have trouble understanding, don't be afraid to ask him to repeat and to speak slowly and distinctly. At first don't try to use your new language when signal conditions are poor. With English you can easily fill in missed syllables and even whole words, but with another language you will need all the signal quality you can get; so wait for a time when signals are Q5.

"A conversation in a foreign language is much simpler for the beginner if he can control it."

A conversation in a foreign language is much simpler for the beginner if he can control it. By controlling the conversation, I mean that you determine the topics discussed and that you arrange the conversation so that the other person does most of the talking. The easiest way to accomplish this is to make your part of the conversation mostly questions which keep the other fellow so busy answering that he never thinks to ask you any. You probably cannot achieve complete control, but you will be surprised how easy it is to give the impression that you have perfected a language if you use this technique. It will also give you a feeling of security at first if your conversational partner does most of the talking, because your ability to understand your new language will always far outstrip your ability to speak it. Gradually your ability to speak will increase, and you can begin to relax your control over the conversation and give the other fellow a chance to ask some questions too.

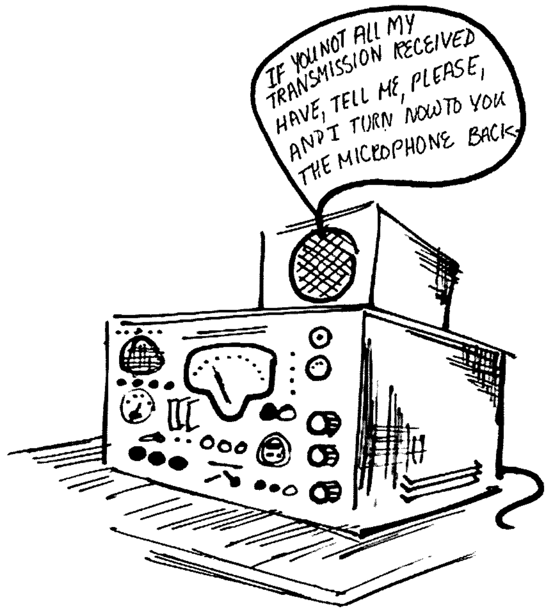
Learning Ham Jargon

You may need some help picking up the special ham expressions or jargon which are necessary for a QSO. You won't find them in standard language textbooks or dictionaries. Your best bet is to get a book giving ham expressions, such as *Ham's Interpreter*, published by DL1CU, Box 585, Stuttgart, or *Ham's Spanish–English Manual* published by August Gabriel, K4BZY, Fort Lauderdale, Florida. DL1CU's book covers ham expressions in French, Spanish, Italian, German, Swedish, Finnish, Serbo-Croatian (Yugoslavia), and Russian. By watching the ads in the ham mags you can probably discover some other similar aids.

A practical way to become familiar with these expressions is to use a tape recorder. Enlist the help of a native speaker in making a study tape. The best procedure is for you to read a sentence in English into the tape recorder, allow a pause of about two or three times longer than was required to read the English sentence, then have your friend read the equivalent sentence in Spanish, German, or whatever. Then go on to the next expression or sentence. For example:

I will send my card directly to you.
Pause, pause . . . . .pause.
Ich schicke Ihnen meine Karte direkt.

On playing back the tape, attempt to give the equivalent foreign language sentence immediately after hearing the English sentence. If you make a mistake, you will clearly recognize it on hearing the foreign language sentence. You will have in effect created for yourself a language laboratory setup with all its advantages – small easy steps, immediate reinforcement and feedback, and infinite patience.



"People the world over find a foreign accent, if it isn't too bad, charming and intriguing."

Final Suggestions

When you are on the air, don't be afraid if you make a few mistakes. Your accent and intonation will probably immediately identify you as an American; but never mind, people the world over find a foreign accent (if it isn't too bad) charming and intriguing. Use a mixture of English and your new language if necessary, but try not to mix them within a single sentence, except possibly for an occasional word. Although FCC regulations require U.S. amateurs to use English in station identification procedures, you will find it most helpful to know well the alphabet and numbers in your new language.

Diligent effort is required to learn a new language, but the rewards are enormous. The combination of DX, ragchewing, plus the magic of a new language add up to many unforgettable experiences.

. . .W7OXD■

An IC Pulser For The Amateur Experimenter

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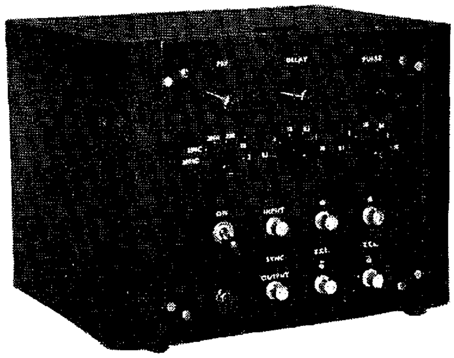


In designing an amateur pulse generator, the first consideration has to be compatibility with ICs. From the standpoint of convenience, economy, or versatility, it has become unattractive to build *anything* digital without IC logic. What this means to pulser design is that the pulser should be compatible with the types of digital ICs one finds himself using most.

Although RTL is the most widely used IC logic family in amateur circles, it is extremely doubtful whether this situation will last. The two types of "current-sinking" logic (DTL and TTL) are far out in front of RTL in industry usage and gaining daily. The reasons for industry preference of DTL and TTL over RTL are several: better noise immunity, higher speed, larger fanout, and a larger selection of devices around which to design.

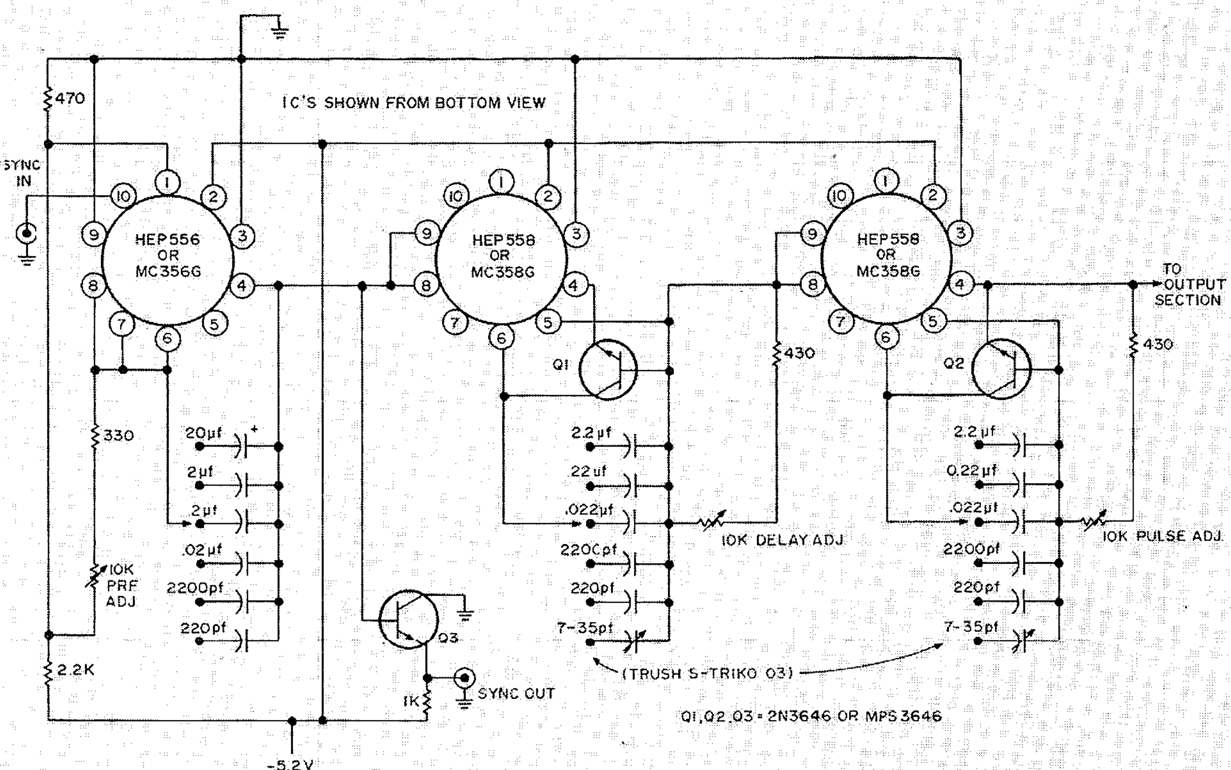


Fig. 1. Pulse generator portion of IC pulser.

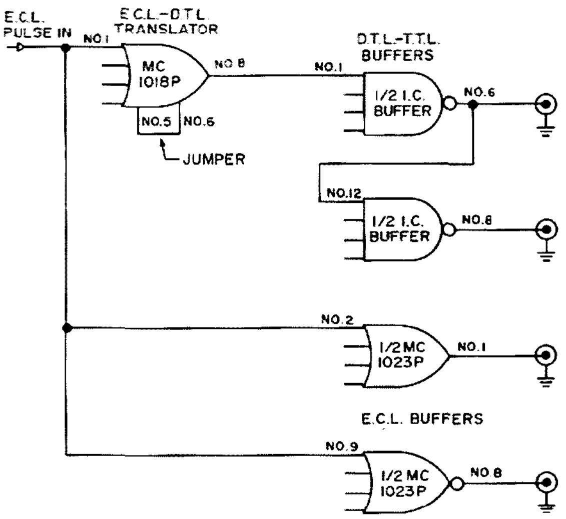


Fig. 2. Output section of pulser.

This pulser was designed so that its output would be compatible with DTL or TTL and also with ECL. The implementation of these two outputs is simplified by use of ICs that are designed for *buffer* and *clock driver* service. (The pulse generator section is shown in Fig. 1, and the output section in Fig. 2.)

The free-running multivibrator which determines the basic "rep" rate, the *delay* one-shot, and the *pulse length* one-shot use HEP versions of MECL ICs. The entire basic pulse-forming system is similar to that of my previous article (*Pulse Generator for the Amateur*, 73, Nov 1967). A number of improvements have been made, however.

By using an etched circuit board, it is possible to reduce lead lengths and get shorter pulses. Longer pulses are also provided by extending the range at the other end of the range switches. An additional transistor has been added to both the *delay* and the *pulse length* one-shot. These transistors allow the one-shots to recover more quickly, providing more stable operation for pulse lengths approaching the period of the basic rep rate.

Since one of the two outputs is to be ECL-compatible, the basic pulse-forming section is powered from −5.2V. This means that V_{ee} (terminal 2 of the HEP 556 and 558s) is connected to −5.2V, and V_{cc} (terminal 3) is connected to ground.

The DTL–TTL portion of the pulser, of course, requires +5V, which is also provided. By carefully arranging the pin numbers of the 14-pin socket, any one of three different families of logic may be used in the DTL–TTL buffer position. The least expensive is the DTL buffer (MC832P). The SN7440N is a TTL buffer that is compatible pin-for-pin. And it can also be used at a slightly higher cost. The MC3025P, member of a different TTL line (MTTL III), can also be plugged in. The cost of the MC3025P is a bit higher than the SN7440N; each step up in cost corresponds to an increase in speed. For two of the types of buffers mentioned above, there are numerous replacements made by different semiconductor manufacturers. These are listed in Table I; they are *not* different families, but rather second-source items.

Table I.

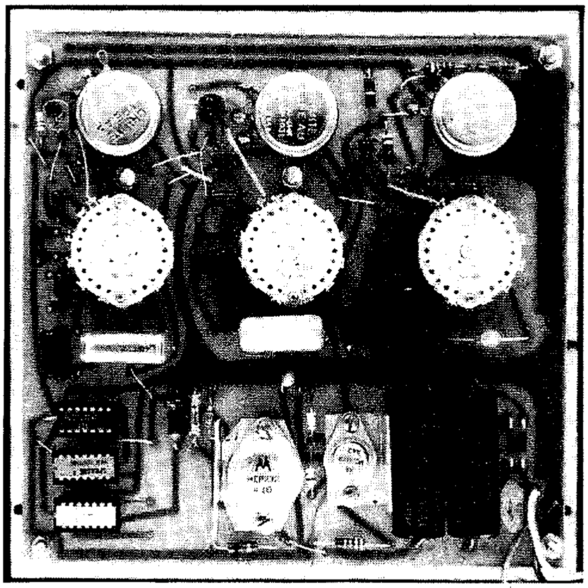
Specified Type	Manufacturer	Equivalent	
SN7440N	Texas Inst.	DM 8040N	National Semiconductor
SN7440N	Texas Inst.	USN 7440A	Sprague
SN7440N	Texas Inst.	N 7440A	Signetics
SN7440N	Texas Inst.	FJH 141	Amperex
SN7440N	Texas Inst.	MC7440P	Motorola
MC 832P	Motorola	DT μL 932	Fairchild
MC 832P	Motorola	SW932-2	Stewart Warner
MC 832P	Motorola	DTL 932	Sperry
MC 832P	Motorola	PD 9932	Philco
MC 832P	Motorola	SN15 832N	Texas Inst.
MC 832P	Motorola	S 9323	Sylvania
MC 832P	Motorola	MIC 932	ITT
MC 832P	Motorola	HSC 932	Hughes
MC 832P	Motorola	CD2306E/832	RCA
MC 832P	Motorola	RM 932	Raytheon

Interfacing *between* the ECL section and the DTL–TTL buffer is an MC1018P *translator* IC. This IC requires ground, +5V, and −5.2V for supply connections. A simplified circuit of the MC1018P is shown in Fig. 3 as used in the pulser. Of course, such a circuit *could* be built of discrete components, but not as simply and inexpensively as using the MC1018P. If the MC1018P is hard to find, the MC1018L may be used. It is the same "chip" in a *ceramic* case, and is being sold at a slightly higher price than the plastic unit.

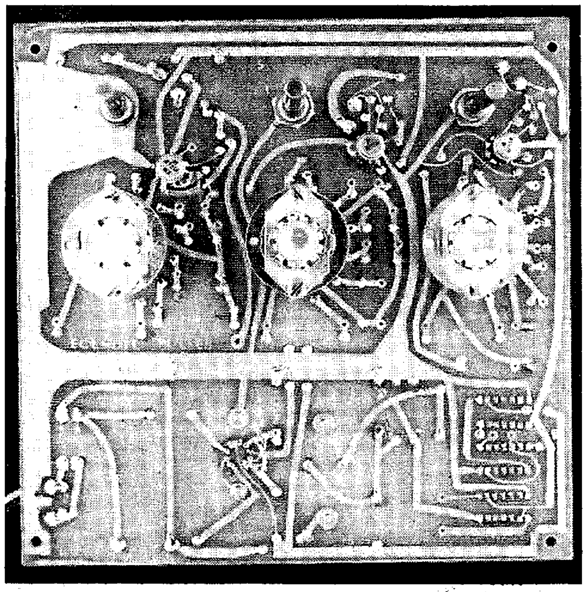
The output section for the ECL compatible pulses is provided by an MC1023P. Although this IC is billed as a *clock driver*, it makes the best output stage of any of the MECL II series. This is true because of its exceptional ability to drive capacitive loads.

The regulated +5V and −5.2V are provided by a common power transformer and rectifier. Since the centertap of the transformer is grounded, the circuit may be considered as two full-wave rectifiers (one positive and one negative) across the same transformer. Of course, the diode configuration comes out the same as a full-wave bridge; so an IC bridge (HEP 175) is used.

The positive regulator is an MC1460R, an inexpensive IC that provides excellent regulation with few external components. The negative regulator is an emitter follower with a 5.6V zener and a germanium PNP transistor. Since the base-to-emitter drop of germanium transistors is about 0.3V, 5.6V minus 0.3V gives us close to the −5.2V required for the ECL−ICs.



Circuit board, parts side.



Circuit board. trace side.

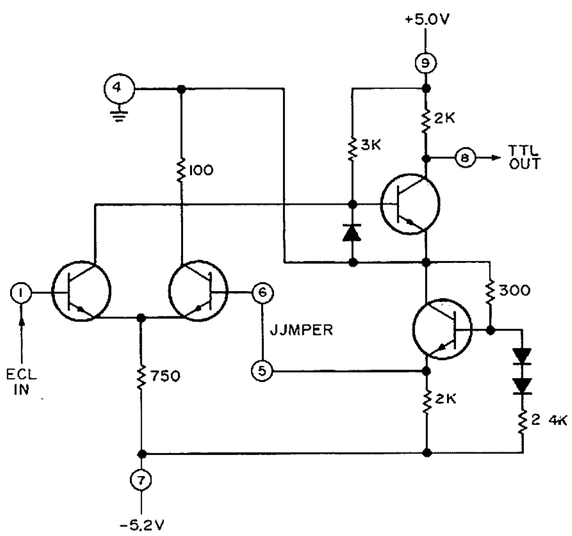


Fig. 3. Simplified ECL−TTL translator IC circuit.

Both the MC1460R and the HEP 232 (PNP power transistor) are diamond-shaped and meant to be fastened to a heatsink. They each have an aluminum bracket attached to them to fulfill this requirement for a dissipator.

The entire circuit of the pulser is built on an etched circuit board. In fact, the wafer switches are assembled so that the board is clamped into the switch assembly. The shafts of the switches are cut to 7/8 in. to extend out the same length as the pot shafts. The entire board is then mounted to a panel using 1-1/8 in. spacers. Some care must be exercised not to allow the spacers to short any of the traces of the circuit board to ground. This can be insured by using fiber washers between board and spacers. The one spacer in the power supply corner is intended to connect the board ground to the panel, so no fiber washer should be used at that corner.

All the components are mounted on the side of the board away from the panel, except the three HEP ICs. These three ICs were reverse-mounted to ease layout, allowing shorter trace lengths.

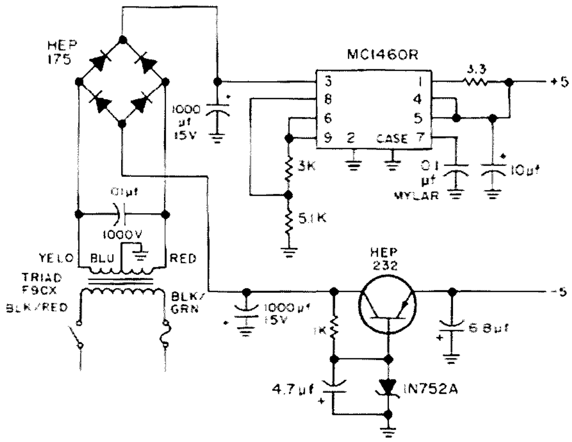


Fig. 4. Power supply for new ECL pulser.

The 7-7/8 x 7-7/8 in. panel is made to fit a Bud CD-1480 cabinet which has enough panel space for all the controls and jacks. The power transformer is mounted (off the board) inside this cabinet.

As to the DTL–TTL output capability of the pulser, it is dependent on the exact type of output stage. Each of the ECL outputs will drive 24 ECL gates (has an ECL fanout of 24). But the fanout of each of the two current-sinking logic outputs is as follows: MC832P – 24 DTL load units, SN7440N – 29 TTL (SN7400N series) load units, MC3025P – 19 MTTL III load units. The load units are not the same for these three current-sinking families, so it is best to use the type of output IC for the sort of family *you* use most. It is quite all right to use any of the types of current-sinking logic ICs with the pulser (no matter which IC is used in the output stage), but some reduction of fanout may be experienced with certain combinations.

Performance

The pulser will produce pulses (and delays) from about 50 ns to 30 ms. DELAY and PULSE switches each have six positions, and the variable control associated with each continuously varies each over at least ten-to-one. Pulse repetition

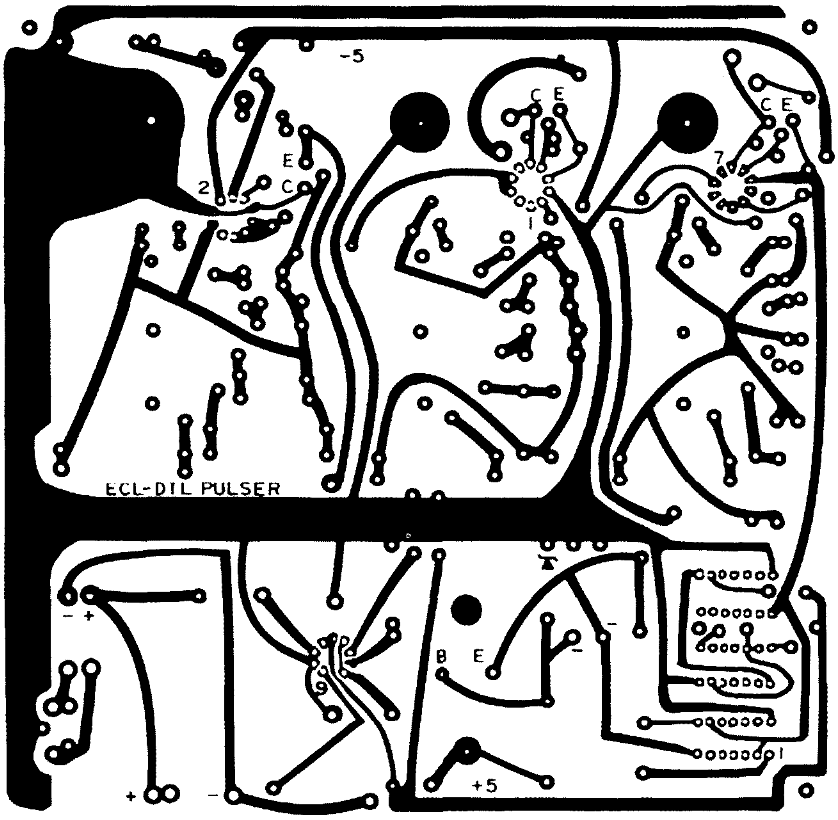


Fig. 5. PC layout of IC pulser.

rate is adjustable from about 0.5 Hz to 1 MHz with a six-position switch and variable control. The labeling of the three panel switches was minimal, with 200 kHz to 2 Hz (in that order, so that the period steps in the same direction as delay and pulse width) for the rep rate. These labeled frequencies correspond to frequencies *within* each switch position, not the center or either end point. The DELAY and PULSE switch positions were similarly labeled from 0.1 μs to 10 ms for simplicity.

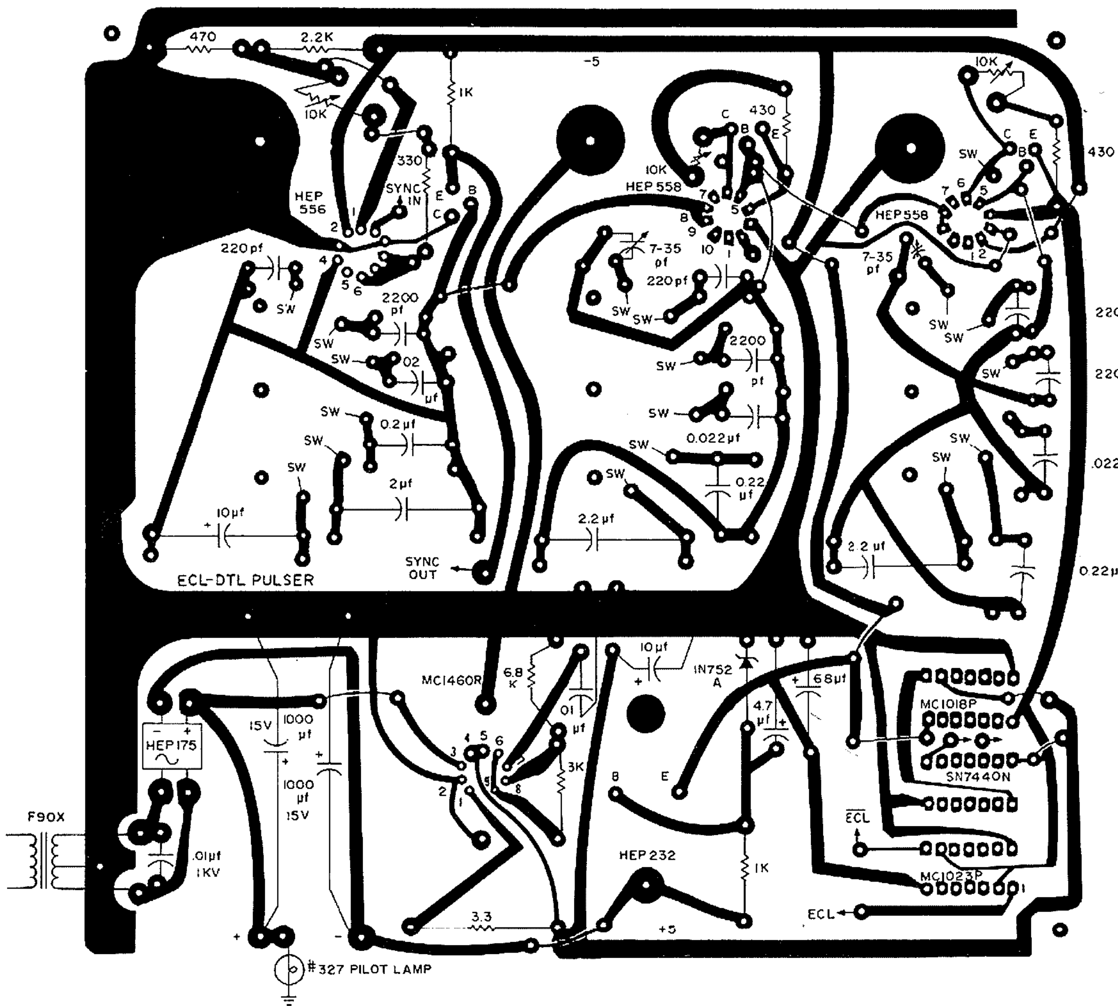


Fig. 6. Component placement (etched side of board shown).

Construction

The entire pulser is built on an etched circuit board, including the power supply, whose circuit appears in Fig. 4. Figure 5 is a half-scale copy of the board.

Since the etched board method has been used, some specialization in components is necessary. The Cornell-Dubilier BR1000-15 filter capacitors are physically smaller than most other brands of the same capacity and voltage rating, and so are best used. Similarly, the switches are Centralab PA-1 and PA-300 combinations, and the two variable capacitors are Trush S-Tri ko 03 types. The IC sockets were HEP 451 for the round-can types and Methode M1141 for the dual-inline types. Figure 6 is the layout of all components on the board.

Both circuit board and a kit of parts are available from Project Supply Co., Box 555, Tempe AZ 85281.

Bibliography

1. Olson, H., *A Pulse Generator for the Amateur*, 73, Nov 67.
2. Renschler, E., *Design of Monostable Multivibrators Using MECL Integrated Circuits*, Motorola Application Note AN233.
3. Texas Instruments, *Integrated Circuits Catalog 1967–68.*

. . . W6GXN ■

Martin B. Weinstein
27 N. Court St. # 335
Athens OH 45701

a DC ISOLATOR for phones

With the advent of recent court decisions which allow attachments to the telephone lines on a noninterfering basis, several amateurs have raised the question of just how they can avoid interference with the telephone lines. Aside from the limitations on frequency and amplitude excursions (these can be automatically limited, as in the Ives[1] circuit), there is a strict requirement forbidding the introduction of dc bias to the telephone lines. Most of the simple amateur phone patches, for example, take no precautions against unwanted dc. Other attachments to the lines may also be offenders.

The circuit shown in Fig. 1 provides a dc-isolated telephone terminal and allows operation of a standard telephone from the isolated terminal by providing talk current to the handset carbon microphone. The design is intended to handle incoming calls only.

Theory

The heart of the unit is isolating capacitor C1. The 0.5 μF value has experimentally proved critical, but the capacitor specified is easy to find and costs less than a buck. S1, the "isolate–normal" switch, disables the unit.

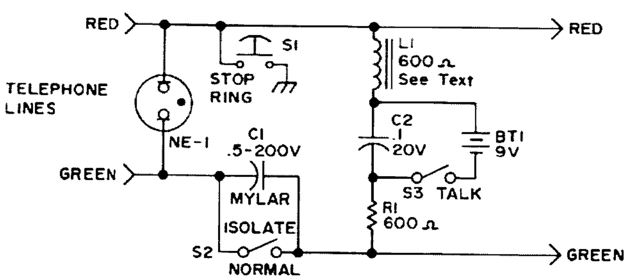


Fig. 1. Dc isolator circuit.

L1, C2, and R1 together endeavor to synthesize the characteristics of a balanced telephone line. The values given were chosen because they look good, they're easy to get, and they work without causing trouble.

Neon lamp NE1 provides indication of ring. S1, connected to an earth ground, stops the ringing. In a standard telephone, the cradle (hang-up) switch cancels the ring by providing dc continuity. Whereas the purpose of this isolator is the avoidance of dc continuity, the earthing of the high line was chosen as a workable alternative.

Construction

There are less than a dozen parts in the isolator. There is plenty of flexibility available in the actual physical layout.

The NE1 pilot light can be almost any neon pilot light, and does not require a current-limiting resistor. Certain individual bulbs have a tendency toward oscillation, but this can be avoided if the bulbs are first aged in other equipment.

L1 is a 600Ω inductor. Slide-rule figures for voice frequencies show an inductance of 30–160 mH. The most economical way to obtain 600 Ω is to use half of a small transistor-type audio transformer. Be sure to place a resistor of matching impedance across any unused windings. 75–100 mH chokes or 88 mH toroids can be tried, if desired.

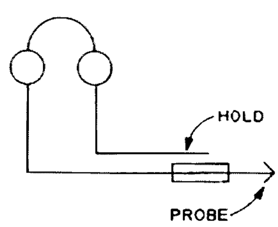


Fig. 2. Connect one wire of headphone (high Z) to each of the phone wires while holding the second headphone lead in your hand. The talk wire with louder hum is one marked "red" in schematic.

B1 can be 6–12V. Most of the units already in operation use 9V batteries; these begin to degrade noticeably in four to five months with a marked reduction in loudness in the talk circuits. The six-pack holders for penlight cells give somewhat better performance and last considerably longer. One elaborate unit was designed with a zener-regulated supply trickle-charging a diode-isolated battery which doubled as an output ballast.

The unit may either be built into a small box and placed in line with your telephone, phone patch, tape recorder, or whatever you have, or if you have a surplus telephone, you can build the unit right into it.

Operation

To answer the phone when the isolator is in-circuit (S2 open, in the isolate position), momentarily close S1 (stop ring) to stop the ringing, then close S3 (talk) to provide talking current.

The isolator performs another trick, one quite useful to those of us with mothers-in-law. By answering the telephone on "isolate" without hitting the "stop ring" switch or activating the talk circuit we can hear the party calling us before the telephone is actually answered.

One word of caution: Use the isolator *only* on calls from local telephones; its use on long distance (or for that matter, pay phone) calls will *not* allow the call to be properly registered on the telephone company's automatic billing equiment. THIS CONSTITUTES FRAUD AGAINST THE TELEPHONE COMPANY and does not allow proper operation of telephone equipment, which is precisely what this unit was designed to avoid. . . .Weinstein■

1. Ives, Ronald L. "A Deluxe Hybrid Phone Patch," CQ, November, 1966.

New Hope For Learning The Code

The Novice license has reduced ham theory and regulations to a manageable size, but even at 5 words per minute, the code still prevents many people from getting their ticket. A young firm in Massachusetts has come out with a new booklet which should help many get over the stumbling block.

Learning the code consists of learning the alphabet and then bringing one's comprehension up to a usable rate. Contrary to the standard rule of learning the code solely by sound, *The ABCs of Morse Code* uses modern educational theory to teach the code by sight and word association. Using childishly simple drawings, the unknown code letter is associated with a common word-picture. The figure shows a sample page from the book.

Amazingly, within two hours people really can learn the code. We tried the book on some of the non-ham staff at 73, and we were amazed. In half an afternoon, these staffers were writing notes back and forth in code and slowly copying messages.

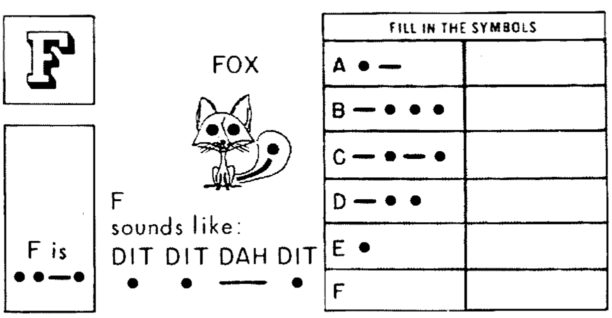


Fig. 1. Sample page from the book shows the simple word-picture-code-letter association.

Emperor Imponderable Morse had been shown in his nakedness. He was conquerable.

We are not saying that in two hours you can take your Novice or Technician test. This course is only a first step. A good tape or record course should be used to gain a facility with the letters. What this course does, however, is to destroy that widespread myth that the code is impossible or that the only way to code mastery is through tedious practice. When you are sending messages back and forth after an hour, it is pretty hard to convince yourself that the code is difficult.

The $1.75 for this booklet includes the free self-confidence, myth destruction, and hope.

Many say that learning the code visually cripples future attempts at increasing speed. Future growth with this method may be a little slower but will probably depend more on the desire to get the General or to get out of the 80-meter Novice ghetto than on the original method used to learn the code. Once you hold your Novice or Technician license you can ragchew about the best way to increase your speed – but you'll be doing this ragchewing over the air – and not on 11 meters.

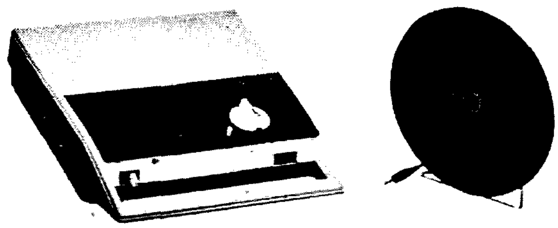
The ABCs of Morse Code is available for $1.75 by mail from tech/media, 5 Central Square, Stoneham MA 02180. Order a dozen or more and the price drops to a buck apiece.

. . .WA1KWJ■

73 LOOKS AT THE ASTRO-MIKE

Bell & Howell has come out with a combination cassette tape recorder and parabolic mike that may tickle your fancy. Of course, if you've never had the yen to record bird songs and things like that, perhaps you've never felt the need of such a contraption.

It is nice to be able to take the recorder out in the fields and woods and tape some of the birds and other nature noises. The parabolic mike lets you do this without picking up all of the extraneous noises that otherwise would mar the recording.



You can have fun recording sports with it too, and even conversations that are far enough away so the people would never suspect that you are taping them. It is great for recording concerts and entertainers. If you've tried to record things at a distance with a regular tape recorder you know by now how terrible the results are. That comedian on stage down there is drowned out by the talk around you and the rustle of the audience.

The set costs $54.95 for B&H. It's called an Astro-Mike kit.

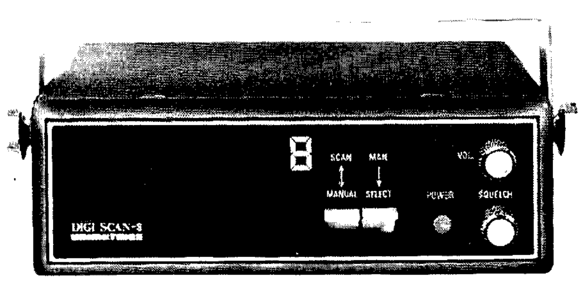
Everything necessary to get in on the fun.

73 Tests the Gonset Super Scan Receiver

and blows its mind!

Eight channels! That's right this receiver listens to eight two meter FM channels almost simultaneously. Someday every transceiver will have to come to this type of receiver. . .it's *that* good. Once you get used to listening to every repeater and simplex channel that is in use in your area – and you get used to this almost as soon as you turn on the scanning receiver – you are marked.

The Super Scan has a digital readout so you can see which channel you are listening to. There are eight small switches on the back of the receiver which enable you to turn off or on the channels being scanned. This is handy when, say, 94 is



The front of the Gonset Super-Scan. Simple, modern, and functional layout is carried throughout the rig.

busy and you want to keep an ear peeled to the other channels. By switching off the 146.94 MHz position, the receiver will scan all but that channel.

The automatic scanner searches the eight channels in a little over a half a second, so not much gets by you. There is a front panel switch so you can turn off the scanner feature and switch channels manually.

Also on the front panel are the usual squelch and volume control. The power on-off switch is a push button instead of the volume control switch. This is nice because you don't have to turn off the squelch and check the volume every time you turn the receiver on.

The receiver is powered from either 12V dc or 115V ac, which is a very handy feature. The change is made just by switching power cords. Powering twelve-volt equipment can be a misery when you want to use it in the ham shack. Not many of us have an extra twelve-volt power supply that is quiet enough to run transistor equipment. One of these days we may build a power supply to run mobile equipment, but in the meantime we get by with a small wet battery (robbed from a Heath Boonie Bike) and a battery charger to keep it alive.

One very nice feature of the Gonset Super Scan is that it is shielded well enough to operate even with nearby transmitters perking. Some of the other scanning receivers just collapse when a transmitter is turned on in the vicinity. This has been annoying at hamfests and conventions where it is particularly nice to be able to listen to as many different channels as possible. Solid state receivers like this are particularly sensitive to strong rf, so Gonset has done a much better than average job of designing in this receiver.

There is a small speaker built into the receiver plus a jack in the back for a remote speaker if something more substantial is desired.

Mobile mounting hardware is included with the unit. This is just the thing to add to the car for the ham that has almost everything and wants to make it everything.

New Mark Products $30 Battery-

What's a battery-boost regulator? I wondered, too, so I asked Mark Products Company to send one along so I could find out. From the photographs, it appeared to be a power inverter although its function seemed to be more of a constant voltage device. Even more interesting, to me, was how such a unit could benefit the mobileer.

Turns out the new Mark entry, designated Model BBR-1216, is a solid-state direct current regulator which provides an extremely stable, constant voltage output to ham, Citizens Band and business radio transceivers – thus providing optimum power output on "transmit" and improving receiver sensitivity significantly.

To appreciate this unit's value, however, it has to be conceded that the performance of any solid-state communications equipment – and particularly FM gear – is closely dependent upon the supply voltage. Output power of your transmitter varies greatly as the supply voltage changes, and the overall receiver sensitivity and gain increases as the input voltage furnished by your car's electrical system is increased.

Why Problems Occur

If your automobile is anything like mine, quite large loads are placed upon its electrical system supply: the headlights, air conditioner, and a great number of accessories draw large currents from the battery.

by Robert M. Brown

Boost Regulator

As a result, the supply voltage to mobile communications equipment can vary from as low as 11 volts to around 16 volts. If, in an attempt to guarantee a high system voltage, the alternator-regulator system is set at a high level, there is serious danger of burning up the battery – and in all cases battery life is shortened.

Mark Products Battery-Boost Regulator model BBR-1216.

What Mark's Battery-Booster Does

According to Mark's engineering staff, the BBR-1216 was developed as an interface device between the automobile battery and the communications transceiver. But what actually happens and what value is it?

The regulator first boosts the available battery input voltage to a higher value and then delivers a fixed regulated output voltage to the equipment. Regulation of the output voltage is excellent from no-load through to the full rated output load of two amperes maximum. The unit has extremely low loss, is highly efficient, and has proved rugged and reliable under test.

I found the BBR-1216 provided a significent boost in range of communication with our two meter FM unit in the car. This came about as a result of increased power and improved receiver performance. Not immediately appreciated, however, is the fact that the unit also acts to protect the transceiver from the destructive effects of electrical system voltage surges.

Installation – Set and Forget

After locating a suitable flat surface for mounting on the car's firewall, I marked hole locations using the regulator as a template. With a #32 twist drill, the next step was to drill the four holes and mount using sheetmetal screws thoughtfully supplied for these purposes by the manufacturer.

The simple interconnections are best made per diagram supplied with the unit. The heaviest practical wire size should be employed; I used about eight feet of 16 AWG insulated, making direct connection to the car's battery.

If you plan to install one of these dandy devices, *do not* operate it from a battery eliminator, etc. Such units running from the 117V ac line do not have sufficient capacity to supply the necessary peak currents. The BBR-1216 has been designed for use with lead-acid storage battery systems only. Mark engineers, however, suggested that if one must operate from some kind of battery eliminator, it is necessary to place at least 30,000 mF of electrolytic capacitance across the battery eliminator to provide for leak currents. Possible solution: you can run the BBR-1216 from a 12V dc storage battery on the bench and a battery charger may be "floated" across the battery at all times when the BBR-1216 is operating.

In hookup, proper observance of polarity must be foremost in mind when connecting the unit to the battery. Negative ground must be used or a transistor will blow out! (Incidentally, improper polarity voids Mark's otherwide excellent warranty).

A feature I appreciate is that both input and output fuses are mounted inside the well-constructed unit (6 ampere, 3AG is the input; 3 ampere, 3AG is the output).

Opinion

It's not often I make a blanket endorsement of anything. In fact, this will probably be a first. Yet I feel the Mark Battery-Boost Regulator represents a significant advance in the state-of-the-art for two-way solid-state communications equipment. In fact, it's my opinion the unit should be employed in every mobile installation to insure that the equipment always operates at maximum design effectiveness.

Mark Products Company is located at 5439 West Fargo, Skokie, Illinois 60076.

Mark Model BBR-1216
Technical Specifications

Input voltage: 11–15V dc.
Output voltage: Preset at the factory for 15.5V dc. May be field adjusted by means of internal adjustment for any output voltage from 12 to 16V dc.
Output Current: Up to maximum of 2 amperes. Output is regulated to deliver preset voltage from no load up to this maximum current drain.
Solid-state devices: Thirteen; 10 transistors, 2 diodes, 1 zener diode.
Fuses: One 6A input and one 2A output. Note: Input current drains when operating typical solid-state 5-watt transceiver: Receive: 0.5A, Transmit (carrier): 1.8A, Transmit (modul.): 2.7A, Transceiver "off": 0.2A.
Control: On-off switch. When switch is "off," transceiver is directly connected to vehicle's battery.
Dimensions: 5 3/8 in. wide by 2 5/8 in. high by 7 in. deep.
Weight: Two pounds.
Price:

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CANAL ZONE	21	14	7	7	7	7	7	14	21	21	21	21
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A = Next higher frequency may be useful also.
B = Difficult circuit this period.

#133
October 1971
One Dollar

AMATEUR RADIO 73

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73 MAGAZINE

#133 OCTOBER 1971

FEATURES

STAFF

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Cover: Posterization of the Regency HR-2A FM transceiver as cooked up by Roger Block.

Amateur Radio

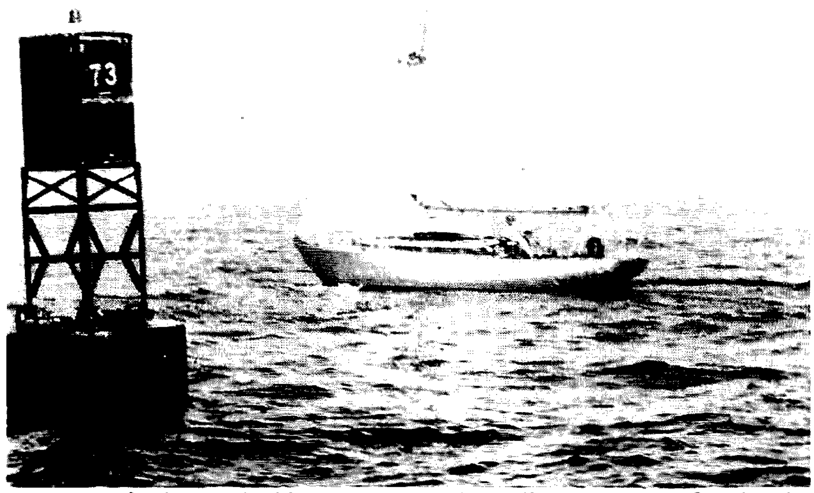
OCTOBER MCMLXXI | **Monthly Ham**

REVERIE SAILS

K. M. Raupach WA4CYX

July 3, 1971, was the beginning of a spirited adventure, an idea which had been germinated several years ago by "Tex," K4MJZ (William B. Zammit) Often you hear people talk about buying a boat and "taking off" for a year or so, but how many of these dreams actually materialize? Well, in Tex's case they have.

I had the good fortune of meeting Tex several years ago as a result of ham radio, what else? I can't recount the many pleasant times we have had since, in fact every one that has ever been associated with Tex has said the same thing. The thought of taking a world cruise, leisurely, fanned my enthusiasm as much as it did Tex's, and as the years went by the idea began to gel to some degree of consistency. It has to be admitted that during this time there were misgiving thoughts about the project but with determination the plan was finally culminated. The problems, were, in many instances, gigantic, like selling a house and all the furniture plus other miscellaneous things including radio equipment that he thought he might need some day. All this had to go, as a boat just couldn't possibly hold it all. More compelling was finding the right boat, at the right price, and outfitting it. Tex accomplished all this with success. I was happy to have had a hand in some of this and acted in the capacity of backup support. I guess we all need that at times. Finally, the day came when Tex said, "I found my boat." When I first saw his boat, well, it's hard to describe the feeling, because I knew he had the right one. Now came another problem, renaming her. After much thought and head-knocking, the name "*Reverie*" came through. Webster in one instance describes *Reverie* as a "dreamy, fanciful or visionary notion or daydream." Tex thought this was great because this was one daydream that came true. I had to agree.



Following the purchase of the boat came the hull painting, stocking up of supplies and material, plus correcting a number of things and taking numerous shakedown cruises on the Chesapeake Bay. Some of these were cold, wet days, some shrouded by fog, and others were just too pleasant to describe, especially watching the sun go down and then sailing under a bright moon, with a fair breeze. During all this time, Tex was practicing up on his navigation and acquiring what seemed to be bushels of charts – so necessary for the journey ahead. A few months before Tex sailed, I had to travel and couldn't get to Annapolis, Maryland, where the *Reverie* was berthed. On those weekends that I did manage to get there, we always headed out. During the last few weeks before departure, Tex told me he was busier than a "cat on a hot tin roof" and you can believe that, since the magic day was drawing closer.

The weekend of July 3rd was approaching. Being out of town, I was getting a little jumpy, as I had to be there when Tex left. With some luck, I did make it, and Saturday morning turned out to be beautiful. The sun was shining bright, the sky was clear, with a few cumulus clouds scattered around. Most of all, the breeze was just right – so necessary for a sailboat. I arrived at the dock at 10 a.m. and at that time there were quite a few people gathered. The *Reverie* was decked out in all her splendor, with flags flying. What a colorful sight she was. Tex and his shipmate, Steve Titus, were busy making last-minute preparations and welcoming everyone aboard.

Perhaps this is the time to make mention of Steve, not that he was neglected before. Steve is a fine young fellow who realizes that an opportunity of a lifetime has been presented to him. He really appreciates it, too. I had time to observe Steve during some

FLASH FROM GENEVA

Despite attempts to open up 50, 220 and 1250 MHz for amateur satellite communications, The World Administrative Conference on Space Telecommunications has authorized amateur radio satellite communications on the following bands: 7.0–7.1, 14.0–14.25, 21.0–21.45, 18.0–29.7, 144–146, 435–438 and 24000–24050 MHz. Attempts to open up 50–54, 146–148, 220–225, more of 420, 1250–1300, etc., were frustrated. Since only the 144–146 MHz allocation was authorized previous to the meeting, we did not come away empty handed. But it is a shame that we were not better prepared to hold our UHF allocations since with satellites these bands should soon become world-wide bands. With synchronous satellites on the 1250–1300 MHz band hundreds of thousands of amateurs could QSO each other through the flying FM repeaters. Well, perhaps we can get started on the nice 50 MHz band they gave us up at 24000! That's just below light waves, isn't it?

Future Citizens To Be Licensed

The Goldwater-introduced Senate Bill 485 which would permit future citizens of the U.S. to get amateur radio licenses has been passed both by the House and Senate and awaits only a Presidential signature for enactment. This is indeed good news to many foreign amateurs in our country who are awaiting their citizenship.

ENGWICHT AWARD ANNOUNCED

San Jose, Cal. – The first Harry Engwicht Memorial Award has been presented to Philip E. Deaver, WB6QLZ, of Hayward, Cal.

The scholarship, which is $200 this year, is to be awarded annually to a junior electrical engineering student at San Jose State College on the basis of scholarship, eligibility to hold an amateur radio license, and membership in the I.E.E.E.

The late Harry Engwicht established a radio engineering department at San Jose College in 1934 and taught communication and electronic engineering there until his death in 1969. He was a pioneer in amateur radio, holding the call W6HC.

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of the shakedown cruises, and he is the type of fellow, in my opinion, who "turns to." He very rarely has to be told what to do, and he watches the every move of the *Reverie*. After watching him, you quickly realize that within the short period of time he has been aboard the *Reverie* he has become a living, breathing part of her. Steve isn't a ham yet, but I'm willing to wager that before this voyage is over he will be fully qualified, if I know Tex. They will have time for that theory study and code practice, believe me.

Back to departure. More people gathered, Steve's mother and other relatives, friends of Tex's, including his former boss, and other people at the dock who couldn't help but realize that something special was up. Tex being the enterprising guy that he is, broke out a bottle of wine that had a neck on the bottle four feet long. Much to my surprise, it happened to be one that I had given him two years before as a gift, and at that time he said, "I'm going to have to save it for a special occasion." What could be more special than this? Even pouring from a container of this proportion proved to be somewhat of a chore, but with the able assistance of a lovely brunette, Jeanie Clarkson, the job was competently completed. Tex polished off the remainder by elevating that thing in the air only after everyone toasted Tex and Steve to a happy and successful voyage.

The departure hour arrived – streamers began to fly over the stern of the *Reverie* and Tex and Steve had their share draped over them, too. They climbed aboard and Tex started the auxiliary engine. The moorings were slipped, and at exactly 12:13 p.m., July 3, 1971, the *Reverie* cleared her berth, heading out the channel to the Chesapeake for a world cruise for amateur radio.

Ned Lentz, WA3EXE, and his lovely wife, Pat, were there with their 38 ft cabin cruiser *"Indolentz II."* We climbed aboard and followed Tex and Steve out. Once out in the bay, Tex and Steve removed the sail cover and hoisted the main, followed by the big jenny. The light breeze quickly filled those beautiful sails, then Tex brought the *Reverie* around to a true course south, and she responded like the perfect lady she is. Several times we pulled up next to Tex and shouted messages back and forth. I said to him, "I wish I were going with you." His reply was, "I wish you were, too. This is the greatest day of my life."

As you can guess, camera shutters were clicking furiously. We followed the *Reverie* out to buoy 73 and knew this would really top the performance. Tex made some runs for it, so that we could get more pictures. Finally he said, "It's time to get back on course." So with that, the *Reverie* "came about" and with arms waving, shouts of "good luck" and "smooth sailing," we in the *"Indolentz II"* turned and headed back to Annapolis. I watched the *Reverie* until she was out of sight and said to myself, "I'll be joining you soon."

If all goes well, I plan to meet Tex and Steve at Mayaguana, BWI, during the latter part of August. We will be on the air with gusto and looking for those contacts. During Tex's and Steve's travels they will be coming up on 14.295 and 21.350 about 10 a.m. every morning, providing they aren't having any problems with weather.

Left to right, Steve and Tex.

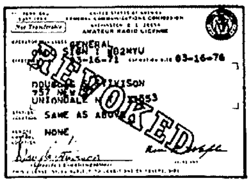
ILLINOIS HAM-OF-THE-YEAR

Photo by Jordan Kaplan W9QKE

Elmer P. Frohardt, Jr., W9DY, is presented with the 1971 Illinois Amateur of the Year Award by Ralph King (K9YSH), President of Hamfesters Radio Club, sponsors of this award, at their 37th annual hamfest held August 8 in Sante Fe Park, near Chicago.

W9DY has been licensed since 1939, and devotes a great deal of his time teaching and helping young people obtain their amateur radio licenses. He is on the DX Honor Roll, a member of The Intruder Watch, a long-time official observer, President of the Radio Amateur Megacycle Society, and former president of the Northern Illinois DX Association. He holds the amateur Extra class license, the 2nd class commercial telegraph license, and the 1st class commercial phone license. He works as a radio operator for the Illinois State Police.

WITH THE FCC



Foreign Operator Permits Granted

The FCC announced the granting of 55 operator's permits to alien radio amateurs. The permits allow temporary (up to one year) operation of an amateur radio station within the United States. Twenty-two nations were represented in the group, and Canadian amateurs were not included in the list. Aliens wishing to operate in the U.S. should apply to the FCC, using Form 610A.

FCC Retirees Active

Many former FCC employees can still be found conversing among themselves on three separate nets. Along with well over a dozen former FCCers, the nets are often joined by many former commercial broadcasters. Besides a strictly CW FCC net, there is the "Old Goats Net" on 7210 kHz and the "Seven Day Weekenders Net" on 14285 kHz.

CLEGG BOUGHT

E.T. Clegg Associates, E. Hanover, N.J., has recently been acquired by International Signal and Control Corporation, Lititz, Pa. The entire Clegg facilities have been moved to ISC's modern two-plant facilities at the new location. Mr. Clegg, W2LOY, has joined ISC as Director of Communications Research, Clegg Division. Among his staff of development engineers are Dick Somes, W3DNV, and Bob Witmer, K3VAX.

Mr. John Kryder, VP for sales, stated that "The Clegg Division will concentrate on the continued development and production of high quality VHF and UHF (AM/FM and SSB) equipment, with a heavy emphasis on customer service. The Clegg Division will also continue service on the ZEUS, INTERCEPTOR, 99'er, THOR, VENUS, 66'er, APOLLO, and VENUS SS BOOSTER equipments. Users should, however, write ISC describing the failure or problem prior to returning a unit to ISC to ascertain the availability of repair parts. Instruction manuals on all of the above equipment will be provided by ISC at a price of $5 each."

CORRECTION

IC Audio Processor, July page 16.

The B+ bus goes only to #2 on the first IC and #4 on the second, and nowhere else.

AMA & CBers BACK EYEBANK NET

Both the House of Delegates of the American Medical Association and the national headquarters of REACT have announced to the FCC their support for a revision of the amateur regulations to allow greater ham involvement in behalf of non-amateur organizations.

The FCC is presently conducting an inquiry into the use of amateur radio stations for non-amateur organizations. In particular, the major question seems to be whether hams should be allowed to use amateur radio for the Red Cross, Eye Bank Association, March of Dimes, local service clubs, and similar public-spirited groups.

REACT – the National Citizens Radio emergency public service organization – issued a statement narrating the history of ham and CB cooperation during recent natural disasters. The statement continued with:

"REACT recognizes the outstanding public service contributions made through the years by amateur radio in the public service communications area and most strongly supports the contention that such activities should be permitted and encouraged in behalf of radio amateurs and the American public."

The AMA declaration also documented the amateur's traditional record of outstanding service in saving lives and providing health care services, both on a daily basis and in times of emergency.

However, the AMA proposal authored by Dr. John B. Dillon, WA6EWV, of the UCLA Medical School, would seem to remove the question from one of amateur frequency use. The AMA proposes the allocation of a special band *outside* of the regular ham bands solely for use by approved organizations in health care service. The AMA proposal made no other comment on the use of actual ham frequencies nor on non-health related groups such as Scouting, Kiwanis, and municipal organizations.

The AMA resolution is reprinted from *Worldradio*:

Whereas Amateur Radio through individuals or clubs has rendered valuable and frequently life-saving service in assisting the provision of health care services through consultations, acquisitions of equipment and medicine, and other vital activities, as illustrated by the long existing Eye Bank Net and activities of the Red Cross during disasters as a purely public service with no monetary considerations, and frequently at considerable personal expense; and

ARMED FORCES COMMUNICATIONS TEST RESULTS

This year's annual Armed Forces Day Communication Tests sponsored by the Department of the Army, Navy and Air Force once again proved to be a highly successful event.

Five military radio stations, WAR (Army), NSS (Navy), NØNNN (Navy), and AIR (Air Force) located in the Washington, D.C. area; NPT (Navy) in San Francisco; and NSSAM/NPGAM (Navy aircraft East and West coast) and an Air Force aircraft East Coast conducted the communication tests on 15 May 1971. The tests included military-to-amateur crossband operations and receiving contests for both continuous wave (CW) and radioteletypewriter (RTTY) modes of operation.

There were 467 perfect entries for the 60 word per minute RTTY message originated by the Secretary of Defense. A Certificate of Merit has been mailed to all those individuals who submitted a perfect contest entry. It should be noted that there were more perfect radioteletypewriter contest entries than CW, demonstrating the increasing competence of the amateur radio operator in this mode of operation.

Whereas the need for providing medical assistance locally and internationally through all possible facilities is clearly apparent and incontestable; and

Whereas newer techniques particularly that of utilizing satellites have and will, in the future, free up previously occupied high frequency channels;

Therefore, be it resolved that the House of Delegates of the American Medical Association indicate to the Federal Communications Commission their support of the concept of the allocation of a special band of frequencies outside the Amateur bands to be used be duly licensed radio amateurs for the sole purpose of assisting in the providing of health care service particularly in emergencies through organizations and clubs such as Red Cross, Eye Bank Net, Radio Clubs associated with Medical Schools and the Medical Amateur Radio Council, Ltd. or other groups duly approved on application for such activities by the Federal Communications Commission.

WASHINGTON TOWER CASE

Sequence of events:

7-3-70	WA7GQC applied for building permit to City of Everett (WA) for erection of 90 ft ham tower and beam. Denied because of 35 ft zoning restriction.
7-17-70	Applied for variance to exceed 35 ft. restriction.
8-3-70	Board of Adjustment postponed decision. WA7GQC hired attorney.
9-14-70	Variance denied. (Neighbors objected, height not necessary, unsightly.)
9-15-70	Requested reconsideration.
10-5-70	Variance denied. (35 ft limitation is not undue hardship on hams.)
10-15-70	WA7GQC advised city he was filing suit.
11-9-70	City Attorney and Assistant City Attorney decided restriction was not legally applicable to hams. City issued building permit. Suit dropped.
11-25-70	WA7GQC sued by neighbors and served injunction to cease installation.
12-15-70	County Superior Court ruled injunction invalid. Case back to Board of Adjustment.
12-22-70	Neighbors filed appeal to City Board of Adjustment.
1-4-71	Board of Adjustment ruled City Building Inspector was to revoke building permit.
1-26-71	WA7GQC filed suit against City of Everett and neighbors.
4-30-71	County Superior Court ruled against WA7GQC. There is no Washington State law or Washington State court ruling to guide Washington courts on ham towers. Court ruled Board of Adjustment could interpret zoning ordinance and apply it as they see fit.
5-14-71	At appeal hearing court again ruled against WA7GQC.
6-10-71	WA7GQC filed notice of appeal to Washington State courts.

NOW, WA7GQC is determined to fight this through the Washington State Court of Appeals to get a legal ruling on the rights of ham radio stations to fully apply their hobby on their own residential property without restrictions by arbitrary zoning regulations. A favorable ruling would solve the similar problem of many hams in the state. Although WA7GQC has been able to carry the full burden of all attorney and filing fees to date, costs at the state level will really start to pinch the savings (in fact, the costs are out of sight!). So . . . hams, you are invited to contribute whatever you can. Make checks payable to "WA7GQC Legal Fund" and mail to

Hams Amateur Mobile
Service Club, Inc.
c/o Dwayne Lewis K7KSZ
2026 92nd Ave. East
Everett, Wash. 98201

Fund withdrawals require two signatures, that of the H.A.M.S. Club President and of WA7GQC. Any surplus funds existing when legal actions are complete will be given to the National Cancer Institute for use on cancer research.

Editorial Comment:

One of the basic purposes of the old Institute of Amateur Radio was to provide funds to help hams and clubs fighting court battles which could help all amateurs. No other organization (including ARRL) provides funds for this purpose, and the fighting of such court battles is left entirely up to the individual amateurs, no matter how important the legal precedent involved. Amateurs must accept that the fighting of these cases falls upon their individual shoulders and that they cannot just shrug and expect the ARRL or any other group to pay the freight. Please do send a $5 bill to K7KSZ and help this good fight.

Worlds RTTY Contest Winners

The British Amateur Radio Teleprinter Group (BARTG) was responsible for the scoring and handling of the "Worlds Championship of RTTY" for the past year. They have announced the winner as Giovani Guidette, I1KG.

Giovani was the winner of the "Worlds DX Contest," determined by the best scores in all the RTTY contests held in the past year. He is also among the leaders in the DX Honor roll and has assisted in many DXpeditions offering new countries for RTTY. For an oustanding signal and operating excellence we congratulate Giovani on his accomplishments.

The top ten finishers are listed below, and it is interesting to note that only 3 of the first 10 are from the States. RTTY has really become an international mode of communication.

1. I1KG – 120	6. W4YG – 60
2. VK2FZ – 80	7. VE7UBC – 59
3. I1CGE – 73	8. VK3DM – 55
4. I1CAQ – 69	9. VE2LO/W6 – 44
5. WA2YVK – 64	10. FO8BS – 41

HOT GEAR!

Hallicrafters SR46A #446100, contact WA1EMU, L. E. Fitzroy, Box 219, Hinsdale MA 01235.

EDITORIAL BY WAYNE GREEN

Eleven Years!

The first issue of 73 was dated October 1960, making this our twelfth October issue. Little did I expect, back in July 1951 when I mimeographed the first one-page RTTY Bulletin, that it would lead to all this.

Major Format Change for 73

While visiting Henry Radio a few weeks ago I got to talking with Cy Kahn (W6PXH), the Sales Manager, and he suggested that we include a page in 73 now and then which might be removed and used to build a handbook. Many of the foreign amateur magazines do this, so the idea was not difficult to consider.

As I thought over the idea, I wondered why we should stop at just having an occasional handbook page. After all, most of the articles in 73 are essentially just a part of an ongoing handbook. One of the best possible reference shelves you can have is a complete file of back issues of 73.

Why not, reasoned I, plan to make *all* of the articles in 73 so they can be made into a handbook? If we were to plan it that way we could be sure to start all articles on a right hand page and end them on a left hand page, making it so any interested reader could take the magazine apart later on and put all of the FM articles together, all of the logic articles together, etc. And, since no one article would ever be on the back of another, there would be no decision to be made as to which one was most worth saving.

To carry this on a bit further – why not include some pages of reference data to make the resulting handbook even more valuable? And how about publishing all of the circuits that can be gleaned from other sources? We could end up with a very valuable reference book!

Cy, I certainly want to thank you for suggesting the basic of a fine idea. I hope you will be proud of what your meddling has brought about. Now we'll get to work and see what we can do to make 73 into a truly great handbook. If you have any suggestions, please let me know.

All you writers and prospective writers should keep in mind that we will be more interested in state of the art articles than ever – in IC applications, logic use in amateur radio, phased lock loop applications, etc.

C. T. POWER

During my recent visit to Los Angeles I talked with K6RAD, Tom Litty, through the PARC repeater and then met him later at a PARC club meeting. Tom, the president of C. T. Power, invited me to stop by and see his operation in Hawthorne where they are making the 2m power amplifiers for FM which Henry Radio is selling under the Tempo brand name.

Bright and early the next morning (well, fairly early) I headed for Hawthorne and was talked in by Tom through the repeater and then direct on 76. The two meter power amplifiers were impressive enough, with models running up to 100W output! The real mind-boggler was a tiny 220 MHz transceiver which they had in prototype and which they planned on being able to sell through the distributors for under $180. With a rig like that available, it should be no time at all before we start seeing 220 repeaters springing up all around the country. This makes 220 inexpensive and practical.

One of the biggest drawbacks to the development of the 220 band has been the virtual absence of surplus equipment, either military or commercial, to get things started. Without all those thousands of surplus G.E. and Motorola FM units available at a fraction of their cost new, two meter FM could never have gotten started. Something like this 220 transceiver could easily be the spark that will trigger a 220 explosion.

Gene Smith (WA6MJD) on left and Tom Litty (K6RAD), the president of C. T. Power, examine a printed circuit board for their 100W 2m amplifier.

WANTED – CIRCUITS

In line with our plan for presenting 73 as a mammoth handbook, we would like to be sure to publish as many circuits as possible that would be of interest to amateurs. In many cases little explanation is really needed to make a circuit of value for the experimenter or technician. If you happen to run across a circuit which you think would be of interest to other amateurs, please send it to us. This can be a circuit you've worked out yourself, from an applications note of a manufacturer, or from one of the non-amateur magazines. If it is from another magazine, please let us know the issue and publisher so we can get copyright clearance before publication.

Make sure that all of the circuit values are indicated on the schematic and that any special parts are identified. In cases where there are tuned circuits we would appreciate getting data for the ham bands. Keep in mind that 73 is now read in over 200 countries and be sure that parts values are given, rather than just a manufacturer's number. A reader in Japan may not have a good source of B&W coil stock!

ATV REPEATERS

The one factor that has probably done the most to crush amateur television activity has been the little problem of the limited range of the 420 MHz band. Few ATVers have been fortunate enough to live within a stone's throw of another such afflicted individual, with the result that few have ever been able to do more than send pictures to themselves. That may be fun for a few days, but it gets old fast, and the dust gathers on all that equipment.

Getting on television is difficult enough without adding the formidable job of also having to put out a substantial 420 MHz signal, a job that has been hard enough to limit the occupancy of that band to a tiny handful clustered in a few population centers, if we overlook the FM repeater link stations which are usually point-to-point and for control purposes rather than communications.

Now suppose some of the repeater groups started putting in television repeaters! If it were possible to cover the wide areas on ATV that we can with low powered FM equipment, I would be very surprised if ATV didn't start blooming rapidly. Imported cameras are quite inexpensive, and I think that most UHF converters can be coaxed to tune down to our band, so little more would be needed than a small transmitter and a simple interface unit.

Quite a few of the repeater groups are adding a separate RTTY repeater

to their service. Most of these are set up, I believe, to repeat on 146.70 MHz. It would be nice if a few amateurs were to provide a repeater function from this channel down to 20 or 80m. Is anyone doing that yet? Why not?

TIMERS ON REPEATERS

As a converted low band ragchewer, one of my big problems in adapting to the 2m FM scene has been learning to shut up and listen instead of talking all the time. It has taken me quite a while to get used to the idea that repeaters are not to be used at all, only to be there so you *can* use them. If everyone is properly silent it is possible to have hundreds of stations all on one repeater without any interference.

The kick of the whole deal is in being able to communicate if you want to, not in the communicating itself. I haven't yet become hardened in this attitude, but I have visited some old-time FM operators who are able to sit and listen to a newcomer pleading over and over for someone to come back to him through the repeater. They totally ignore this greenhorn who doesn't know any better.

In some areas of the country I have noticed that older ragchewers like myself have ventured down to the repeater world and have set up shop as usual with their long-winded monotribes. I have noticed this when flying over their area, hoping to break in during the split second they stand by for the other half of the affair. Often I am able to pass through the entire repeater area during one hot-air blast and never have a chance to even try and break. Even in the car it is sometimes difficult to get a word in edgewise. I've been able to drive through the whole 100-mile coverage of a couple of repeaters without once being able to break a two-way exchange of trivia.

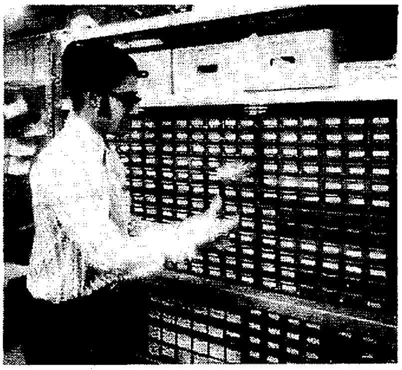
In Los Angeles I ran across a little device which foils these verbal dinosaurs. It is a timer which shuts down the repeater if the input carrier is not dropped for two minutes straight. Some repeater groups levy a fine on the offending op, others just hoot at him. The effect is that long-winded ops don't have a chance to develop their pernicious habit. And the two or three seconds for the repeater carrier to drop out that must be observed every two minutes at the least, gives adequate time for anyone to call in and join the fun, even if he is flying through.

Please understand that I am just as bad as the worst of these bores and boors. Given the opportunity, I am able to sound off for an hour straight, driving my audience – held captive more by the restraints of politeness than interest in what I may be saying – back down to the low bands. The two or three minute timer is one of the best things to come along to curb me and my kind. Let's seriously consider putting these fiendish devices on all repeaters. Okay?

A VISIT TO STANDARD COMMUNICATIONS

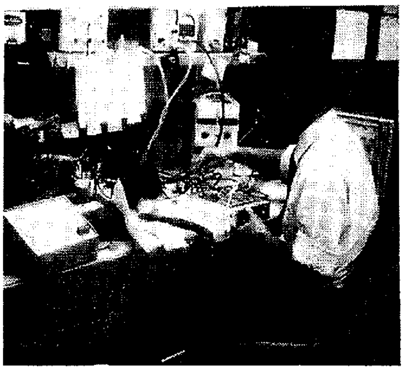
The simple front of the Standard Communications building in Wilmington, California, gives little hint to the bustling activity inside. Stan Reubenstein, the General Manager, took me on a tour of the plant during my recent visit to the West Coast. Frankly, I was quite impressed.

One of the big problems with imported equipment is getting it serviced. Every now and then I remember the Alan Sherman lyric, which ends . . . "If unsatisfactory you should bring it to the factory, but the factory's in Japan so rots of ruck." Standard has brought a lump of the factory service department over here, and they are alive and well in the smogs of lower Los Angeles.



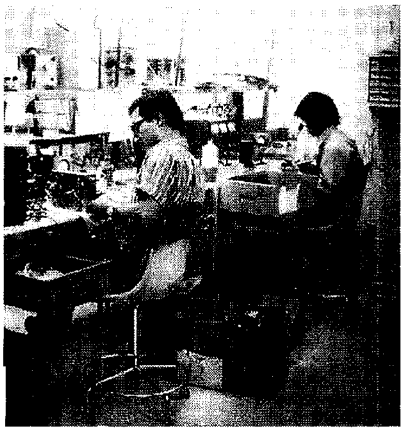
Stan Reubenstein, the General Manager, pulls crystal pairs from the large stock kept on hand. How would you like to be let loose near those drawers full of ham band crystals for about five minutes?

JH1QBV takes time from servicing some 826 modules to look at a Polaroid picture of him servicing 826 modules. Almost all of the service department are Japanese amateurs. Now if we only had reciprocal licensing with Japan they could get on the air through the repeaters.



JH1SCC checks out a new 826 before shipment to make sure the output is up to snuff and that everything is working satisfactorily.

It didn't take very long for Stan to convince me that I should install a Standard 826 in my rented Pinto, complete with crystals for the local repeaters. They have a little plug that goes into the cigarette lighter for power, and I borrowed a magnetic quarter-wave antenna which we put in the middle of the car roof, running the coax in the door to the rig on the seat beside me. It worked fabulously, and I found myself instantly in touch with hundreds of FMers. That rig sure made my visit out there a lot more enjoyable, and you may be sure that I will have it along with me whenever I make any trips.



JA1RVW checks out a new module in an 826. Standard keeps a complete stock of the modules on hand to simplify repairs. It is faster and less expensive to change modules and let the factory service the modules.

Standard, by the way, has just leased a huge building next door to their present building and they are expanding into it. The sales of 826's for amateur and marine use calls for quite a bit of storage area, plus they are setting up a crystal-making facility to help them keep up with the crystal orders. They carry one of the largest amateur frequency crystal stocks that I've ever seen and have just about any pair on hand for immediate delivery.

W2NSD continued

A VISIT TO MANN

All that FM equipment! Hundreds, or is it thousands of FM sets! At the time I visited they had some of those Kaar 120W 2m units right out there where I could eat my heart out. I think that I might manage to get into every repeater in the East with something like that. Of course I wonder what it would do to my car battery. I suspect that it might draw so much current that it would suck the battery right out of its moorings and send *it* through the local repeater.

NEWSPAGE TYPE ENLARGED 12%!

As an experiment we are trying the newspages this month set up vertically with the type 12% larger than in previous months. Of course this means we can't get quite as much material in the pages, but they should be a bit easier to read.

Want to really understand the Mid-East situation?

The *only* clear and concise explanation of the muddled mess in the Mid-East is in the book *"Search For Peace in the Middle East"*, written by the Quakers (AFSC). We have a few of these fascinating books left – first-come, first-served – 75¢ ppd. Radio Bookshop, Peterborough NH 03458.

DX FOOTNOTES

The DX has never been better, so come on down from that 2m FM now and then and grab a rare one. Gus reports some juicy stuff for those that take the time out from jawing to listen – such as AC5PN on 14020–40 around 1330z (If you are one of the few that need Bhutan, W6DDM/KB6 on Canton Island has a whale of a signal on sideband (14285), QSL to Box F160, APO SF 96401. Look for Joe around 0800z. K4CSY/KC4 seems to have activated Navassa again and says QSL to KG4CS or the K4 bureau. Lettuce see about FO8BQ on Tuamoto Island (14023 @ 0130z, QSL to WA6MWG. You probably have EA9EJ in Spanish Sahara, right? No? Well, listen for Justo around 14220 @ 0630z. CR8AG in Portuguese Timor is almost as rare as they come. Look for his listers (like CT2AK) and get set to make a quickie while Adriano's gas generator has fuel. The action is around 14210 @ 1000z and QSL's go to PY7VS, Box 74, Fortaleza, Ceara, Brazil. Should we mention to include 2 IRC's and SASE? We hope not! You've probably all worked a Sao Tome station by now, so if you need a second contact you'll be on the watch for CR5AJ around 14000–13 @ 2100z. QSL Box 68, Sao Tome. M11 is still active, heard recently on 14200 @ 2245z, QSL I1BNZ. Jordan is hopping with hams these days, sorta – JY6RS on 21013 at 2235, QSL Box 2353 Amman! Don't forget the Southeast Asia net on 14320 daily at 1200z for run-of-the-mill Asian DX such as VS6, 9N1, HS, and plenty etc. Want 5X5NA? Get on the W3ZNH list for Saturdays on 21355 before 1800z, QSL G3LQP

The president of the Maldives is 8Q6AA and should be on the air soon. Ask him for a picture for us, eh? The Brisith military will continue to use VQ9 calls. Yemen has been scarce lately, so you might need 4W1AF who has been reported around 21350 @ 1700z. YJ8BL New Hebrides on 14297 @ 2330z, QSL to W6NJU. 7Q7CY promises to be very active on all bands over the Oct. 30th weekend. Check 28550, 21360, 14280, 7090, and 3795 and QSL to K9BNF. VR6TC is on every Tuesday and Thursday on 21353 @ 233-z. George VR4CG comes on 14242 at 1200 and hates pileups, so be careful or you'll lose him. Thanks for all that adrenalizing news, Gus.

The West Coast DX Bulletin has this interesting letter from AC5PN to K6KA, a long-time 73 contributor:

Dear K6KA: Your friends in southeast Asia are very correct to have heard my call. I have very recently started to work on the amateur band. There was Mr. N. Chhawna previously working AC5PN, our ex-Chief Signal Officer of Bhutan. But the said gentleman is no more in Bhutan now. Since he left the country, no substitute dared to occupy his work immediately for want of proper knowledge which continued for the last 5–6 years. I am the newcomer in this line and very new. My name is T Yonten (full name is Thuji Yonten). Before I should regularize my work in amateur bands, I would like to enroll my name in the membership of Amateur Radio and would also like to change my callsign for which I have already written to ARRL. As soon as I get confirmation from them I shall immediately arrange to print my new QSL cards and at that time I shall forward a copy to you.

I shall be very much thankful to you if you please help in providing a regular membership in amateur radio and in changing my call sign as AC5PY instead of previous AC5PN. The technical description of my station . . . transmitter Bel Et 402, 400w a.m. 1.5–30 MHz. Receiver – Bel Ru 536 1.3–28 MHz. Dipole antenna 30 ft high favoring east/west.

I am a bonafide citizen of Bhutan.

T. Yonten
Director, Wireless Communications
D/Tshe, Thimphu, Bhutan

* * *

The situation in Ceylon is still tense, and amateurs there are hoping that their transmitters will be returned soon, but not expecting much in the

VISITING PARC

Recently, while in California, I had an opportunity to pay a visit to the Pallisades Amateur Radio Club in Culver City. They had a very interesting program and a standing-room only crowd of friendly members. Coffee and doughnuts after, plus lots of eyeball contacts. The club, with over 200 members, keeps alive by accentuating a broad approach to amateur radio. They have their own repeater for the FM group (WB6ZDI) and it is probably the most active repeater in the Los Angeles area. They have plenty of DX'ers, ragchewers, Novices, builders, and representatives of every other interest that makes up our hobby. . . .W2NSD/1

way of permission to operate for a while. The Burma amateurs have been greatly encouraged by the return of their transmitters and the re-issuance of their licenses. Perhaps they will get a go-ahead one of these days and precipitate some monumental pileups.

* * *

The RTTY DXers have been very busy pecking at each other. You might hook up a printer and check the high end of 20 CW (14090) and see for yourself. A recent night's play for the more nimble fingered included PZ5RK, EA8CI, CP5AD, 9J2ED, VP7NH, 9Q5BG, 4Z4MR, 9Y4VU, KX6IT, JA1FFX and FO8BO. Not bad for one night! Keep in mind that FG7XT has 110 worked (102 confirmed), with ON4BX at 108 worked, I1KG at 104 and W3KV at a miniscule 103.

From the DX Mailbag:

On November 6th and 7th, the Sunshine Coast International Rodeo will be held at Nambour, Queensland.

Our club has decided to take advantage of this and for the duration of the Rodeo will be operating the club station, VK4SZ, from the grounds. Frequencies will be 14275 and 14175 kHz, and times of operation will be from 1800 to 0700z each day, but these could be altered to suit prevailing conditions. We are having special cards printed, and QSL will be 100%.

P. Cox
SCAR Club
3 Bambaroo Ave.,
Nambour 4560 Australia

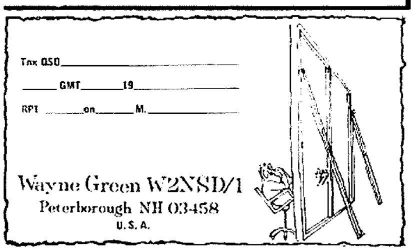
As your newest subscriber and keeping faith with your instructions to "Keep your ears clean and listen for news . . . " I am sending you the following QSL address information for some special calls that I logged.

VB1MSA via P.O. Box 1462, St. Johns, Newfoundland, Canada or the VO1 bureau. (Call issued to commemorate Marconi's Seventieth Anniversary.)

VA2UN via W2GHK (Call issued to commemorate the 100th anniversary of McGill University.)

WF7AIR via K7ABV (Call issued for the Montana State Fair.)

R. Stephen Dildine, Jr.
1900 S. Eads St., Apt. 725
Arlington VA 22202

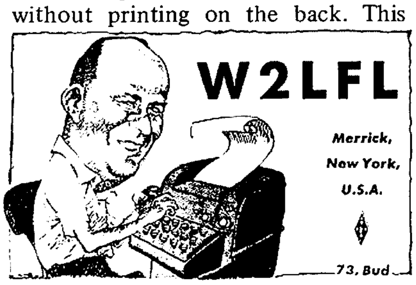


I went up to the International Field Day held near Charlotte, Vermont, and I had a ball. However, I suffered a very severe case of shock when I actually met *two* Vermont Novices. In eight years as a ham and even after a year in neighboring New Hampshire, I was still firmly convinced that Vermont simply did not exist on the Novice bands. Of course, I still *know* that there is no such thing as a Wyoming Novice . . .

Jim Askew, WNØDRO, of Mitchell, South Dakota is willing to give anybody a hand who still doubts that all 50 states are represented on the Novice bands. You can drop Jim a card at 604 North Rowley, Mitchell, S.D. 57301 to arrange a sked. I sure hope Jim has a large mailbox.

If you still have not gotten a copy of *The Novice* you'd better send your SASE to Greg Ginn at 1240 21st St., Hermosa Beach, Calif. 90254. The last two issues have posed some pretty probing questions about ARRL opposition to a 10m Novice band. The sooner a Novice can get into ham politics, the sooner he can start working for the preservation of his hobby.

After a few months on the bands, I'm sure that we all must have a shoebox full of the WRL and W5OWC QSLs. Although they are very fine quality cards and they are sold at really reasonable rates, I'm sure that many of us would like to see something different in the line of Novice QSLs. Custom designs and photo cards are nice, but they can cost a lot. If a group of guys in one town can work out a common design with just the call and QTH changing, you can sometimes have them printed reasonably. Printing is a very competitive business. With some shopping around you can often get a good price. My high school radio club worked out a club design and some club members taking graphic arts printed them for everyone on the school's shop press. An easy way to cut costs is to arrive on a simple black and white card without printing on the back. This



will take only one press run. One of the most distinctive types of simple cards is the caricature card – either humorously done like that in the W2NSD card or more accurately done as in the W2LFL QSL. With some thought and planning, a caricature, your call, the report, and your QTH can appear on one side of the card. Of course it helps to know a friendly artist who would like the instant notoriety resulting from designing a ham QSL!

The QSL from W2LFL was picked up on a recent visit to Bud. A particularly eye-catching feature of Bud's shack was a display of foreign postage stamps – all from the envelopes containing DX QSLs he has received. Although no Novice DXer is in the 200 country range of Bud, it doesn't take very long to acquire 20 or 30 foreign envelopes. Simply arrange the envelopes attractively, glue them down to a piece of carboard (rubber cement works best as it allows you to make changes easily) and make some sort of frame – cardboard, construction paper, or even wood.

Bud also has quite a few hints for Novices (or anybody else, really). Bud keeps meticulous records of his ham activities. Ask about his antennas, and he will pull out charts of SWR vs frequency that he drew himself with dime-store graph paper and his regular SWR bridge. Ask about his CW monitor, and he has the schematic in a loose-leaf binder. While record keeping might seem like a waste of time now, whenever Bud wants to modify a piece of gear he designed or whenever he wants to make changes and improvements in his shack, he has a guide; he has an ongoing record.

Lest one call Bud a fanatic though, Bill (K1CLL), our perennial VHF experimenter, keeps a notebook of *all* his experimental projects. Of course Bill doesn't slave over it. A few sketches, a quick schematic, and a note about a weird junkbox part doesn't seem to slow Bill down, but they sure make troubling-shooting, improving, and duplicating a rig a lot easier. A startling example of Bill's note-taking was a recent antenna building project of ours. I mentioned that I wanted to build a good 20m beam. Bill brought over his notebooks from the 1940's and in them were all the dimensions on lengths and spacing that Bill had worked out over months of experimenting in his commercial antenna test lab. It really saved me a lot of trouble.

So, if you start now to keep all your owners' manuals together and your sketches and ideas, you'll find that you are quickly developing a personally tailored reference library of your own experimentation. .WA1KWJ

LETTERS

TAKE NOTE

I have a few comments to make about my fellow hams. I know that you've probably heard every word, printable or not, that has ever been said about operators and what they call their "operating technique." Well, bear with me because I have a few that obviously need to be rehashed.

About a week ago, I started listening around twenty. I blew my balanced modulator tube and couldn't find a replacement. I was really surprised to see what people like myself sounded like. Now let me get one thing straight from the start. I'm not setting myself up as a prima donna. I guess most of the things I have to say have applied to me at one time or another. Anyhow, I'm trying to cure my problems.

I heard people deliberately interfering with nets, phone patches, and each other. A couple of my friends and I were on one of the mobile nets. The whole time we were on (about 2 hours) there was some "person" tuning up. I use one of the popular transceivers with sweep tube finals. I wish my finals could take a beating like that. Maybe they could use that as an ad for one of the linear manufacturers.

There are other dragons to slay. Where have I heard that phrase before? I have an actual example. I was on 20 at 1600 GMT on July 27, 1971. I called "Is the frequency in use?" three times. So I called CQ and W3MSD comes back, and we started chewing the rag. Well, within five minutes we had three people tuning up and two QSO's trying to talk over us. Sound like your last QSO?

I'm sure that anybody can think of at least one QSO that ended like that. Then we have DXpeditions and certificate stations. Now I love DX as much as the next man, and like everyone else, I never seem to work enough of it. But there is still no excuse for intentional interference and lousy "operating technique."

I think I'll pick on WB4ICJ for this one. Right after the Apollo 15 launch, there they were, handing out contacts in an orderly and speedy manner. That lasted about 3/4 of a minute. Then the big guns came in and tried to break through the system of working five in a call area and then going on to the next one. The crew down there stuck to the system, and for the first time I've actually seen only people in the proper call area say something. My congratulations to the operators down there.

Finally, a word about people who were there first. W4WDT was in QSO with another station about 1 kHz up from WB4ICJ. When he started the QSO, he was the only one on and couldn't have heard WB4ICJ. The point is that W4WDT had the right of prior claim. But WB4ICJ had announced that the frequency would be on at a certain time and place. So who has the rights? Some "well meaning" soul started calling him names. I went down and he politely agreed to QSY, WHEN HE WAS ASKED POLITELY. The moral of this little tale is quite plain and quite old. 'You can get more flies with honey than vinegar." My thanks to W4WDT for QSY'ing and my apologies for my inconsiderate fellow hams.

This can all be summed up in one phrase – "Treat your fellow hams like human beings, and you'll find they'll treat you the same way." If you print this letter, put my name and call in LARGE TYPE. I'm a ham and proud of it. I have a call and always use it. If I've mentioned something that someone recognizes as himself, then change your ways. And if I've stepped on some toes, I'm on twenty from 1530 GMT until the band closes. I know I'll hear somebody QRM'ing me. So answer my CQ and tell me how I trod on your foot, instead of just trying to talk over me. Even if you do drown me out, wouldn't you rather let me talk than have to read another one of these letters?

BOB SHAW WB9FIN
333 Blackfoot Court
Fort Wayne IN 46805

N.C. Ham Plates

It has finally happened! We have been classified with the Class D CB crowd, at least in North Carolina.

The North Carolina legislature in its wisdom(?) decided that the hams were getting off too easily at only a buck extra for call letter plates.(NC cars only get one, so it is plate, singular.) The fee was raised from $1 to $5 per year. Well, that's not too bad – inflation gets everyone. However, our ever-wise state legislature decided that the CBers were entitled to call letter tags at this same rate.

Damned if I want to be placed in the same category with the largest problem the FCC has – Class D CB! Even only on tags. Newspapers already refer to "amateur radio" when they mean CB. How many people will know the difference between a "KKK-1234" tag and a "W1XXX?"

Damn it!!!

For once, here is an issue that all NC hams can get together on. The ham vote is substantial – let's use it to good ends!

F. C. Hervey K4ETZ
Rt 1, Indian Trail NC 28079

REPEATERS

I have read with interest the many articles featured in your magazine and several times the excellent Repeater Handbook by K6MVH. At this time I have several comments and questions on diverse subjects. First, for your information since November 1970 we have here in Fredericton an AM repeater VE1PD operational on 147.800 input and 144.225 output. It gives good coverage to Central and Western New Brunswick and Eastern Maine. It might be something for the DX hounds to look for on inversions, as I expect not many think to look in this direction on such occasions.

The licensee is Claud Bailey, VE1HU. The repeater is located at an elevation of 1325 ft on Crabbe Mountain, 35 miles north of Fredericton with a 5.8 lb. collinear antenna on top of a 300 ft tower, duplexer, and runs a 50 watt base station connected for repeater service. It provides what I believe you refer to as superrange service, having very low desensitization, reasonable power and high antenna gain.

Now we are faced with the same question as proposed in the July "FM Scene," i.e., with 46/94 in St. John, N.B., 75 miles south and in Moncton, N.B. 120 miles east and 34/94 in Charlottetown, P.E.I., 250 miles east, what should we use for frequencies on a local coverage FM repeater, which we hope to have operational by November 1971. I'm partial to 34/94 myself to eliminate overlap entirely, but any advice or other confusion will be greatly accepted.

Frank Ryder VE1AIL

RE: ELECTRONIC HEALTH

As I, together with Wayne Green, have been charged with being potential murderers, I believe I have a right to reply in the same column used by Mr. Shafiroff and also feel it is my duty to other readers of 73 to clarify the situation. My grandfather and the majority of his 12 children, including my father, died of cancer, and my sister had a breast cancer removed, so I have had good reason to become well-informed on the subject.

First, I would point out that the charge of quackery is made with no consideration of the stature of the scientist, Lakhovsky, nor of the opinions given in the books referred to, by qualified medical doctors who used the oscillator in their practice. I do not doubt the sincere intent of Mr. Shafiroff any more than I doubt that he has been brainwashed. On the basis that the simplest effective remedy is

the best, I would much prefer the use of the Lakhovsky oscillator to the remedies he mentions for skin cancer. To condemn without investigation is the surest way to maintain ignorance. A quack is anyone who is more interested in income than genuine aid to others.

I would urge anyone interested in ethics and cancer to read *A Matter of Life or Death"* by Herbert Bailey, and then decide who the murderers are. This book is thoroughly documented, available in paperback by McFadden-Bartell at 60¢. If that is not enough to turn your stomach, try *"Cancer Facts and Fallacies"* by Rodale Press, *"A Cancer Therapy"* (with 50 case histories) by Dr. Gerson, or of the experiences of Dr. Nolfi, Dr. Frost, Dr. Koch, Dr. Wilson and Mucorhicin, of Dr. Lincoln, Hoxey or a dozen others who developed promising cancer therapies only to be ignored or persecuted. Courts agreed that Hoxey cured cancers, but he was put out of business. Prominent Sen. Paul H. Douglas was unable to force our federal government cancer agency to give Krebiozen an honest test. Read the Fitzgerald report to Congress before charging quackery.

Or read the National Health Federation bulletins, Prevention or Let's Live magazines, Health Research publications, or write the Association of Cancer Victims and Friends, 5525 El Cajon Blvd., San Diego, Cal. 92115, and find out who helped them when hope grew dim and purses slim.

When Columbus crossed the Atlantic the American Indians may have had more effective medication for cancer than the AMA has approved up to now. Creosote bush tea, anyone? A real cure can only come about by Nature when intelligently assisted by man. The latter must furnish the tools and Nature does the work. Cancer may be removed by surgery, but technically I do not consider that a cure. Of course I do not oppose surgery under favorable circumstances. I doubt if President Nixon has the power to force the appropriate government agency to test the various cancer remedies of promise and give an honest evaluation of them.

Charles A. Moore
Av. 27 Poniente 2520
Puebla, Pue., Mexico

Silent Key

Perhaps you remember Rose and Ben Hurevitz who went to Europe with you and the 73 gang in 1963. We last saw you in 1968 at the Long Island hamfest. Ben died of leukemia in May 1969, in case some of the many hams that contacted him during his last nine months – much of which was spent on the air – may have wondered at not hearing WA2NWJ recently. If you ever make another group trip, please let me know as I would like to join the group.

Rose Hurevitz
Bellerose NY

PRODUCT REVIEWS

Dear OM,

Why not review the Yaesu FT-101 and/or its companion linear? You hear them all the time!

Guy Blencoe W4HVU

Excellent idea. Perhaps a reader will oblige? I do hear them a lot and would be delighted to get a review. I'm sure that you don't want a review from me for I always say nice things about products advertised in 73 (I know which side the bread is buttered on). Come to think of it, the Yaesu hasn't been advertised in 73. Perhaps a nice review would change that? Note: Lest you think that the dollars cloud my vision, you don't find reviews of bad gear published in 73. If it's good we'll tell you about it. If it's bad we will pretend it doesn't exist. I would much prefer to be able to say bad things, and it would take several pages of examples to prove why I eventually learned (the hard way) to shut up about lousy gear and hope that it just goes away instead of making a big deal about it.

. . . Wayne

BETTER BUSINESS?

I received my Novice license on May 3rd of this year, and I am extremely proud of it. Being an active Novice I purchased a summer edition of the Radio Amateurs Callbook, I have also ordered the supplement which is supposed to arrive on September 1st. In the meantime I have worked quite a few Novices who are not in the Callbook, and I didn't get their complete QTH or I wasn't sure of it, so I wrote to the Federal Communications Commision about 6 or 7 times to find out these Novices' QTH's. They answered me very nicely for the first four times, then they started putting up a fight about answering. Well, I got the seventh letter back today and they didn't even bother to answer my request. Now I wonder, with over 290,000 amateurs who pay $9 every five years for their licenses, why we can't get any better service out of the federal government than this.

Tom Lenzmeier WNØEPO
679-47½ Ave. NE
Columbia Heights MN 55421

If they aren't going to give service they should send your $9 back.

. . . Wayne.

HELP

Last week I received a letter from Roland L. Guard K4EPI. He wrote that he can sponsor me when he finds a good job. He is a good friend of mine and my first QSL manager.

I am now working here in Istanbul. Still, I am always trying to do something to continue my education. I have received only one letter from Tri-State College, Angola, Indiana. The have W9BF Amateur Radio Club and they sent an application with an abridged catalog listing the various programs offered at the Tri-State College.

I must leave Turkey before November, 1971. If not, I'll be a soldier. That's the end of my education. After two years of military service I can't continue my education. I hope there is an American family who can sponsor me. As soon as possible I must find a way before November. This is the situation from my side.

Every month I receive 73 magazine, so I'm very happy to read the latest news and to learn many things from 73. Thank you very much.

Is there any good news from Washington Radio Club for me? May I find a job in the USA during my education? I only hope you and K4EPI Roland L. Guard can do something for me.

My address is:

Selim Canbeken
Kadiraga Sok. 15 Da. 8
Goztepe, Istanbul, Turkey

Isn't there one family in the whole country who can sponsor Selim so he can come to the U.S.? Selim is a very bright young lad in Turkey (TA3SC) and has even managed to build his own slow-scan receiver before having his equipment confiscated by the government (amateur activity is not permitted in Turkey). He wants to come to the U.S. desperately, but cannot come until someone agrees to sponsor him. There must be a ham somewhere out there who can help this lad.

. . . Wayne

HA!

There are too many flaws in WN4ONW's article, "DX From The Stars" (Aug. 71) to make it worth commenting on.

How ridiculous, a Novice with an all-band mobile fone rig – one with all bands active late nighttime in October, too!

Ron should have written the "Enquirer."

Ha!

Ed Howell W4SOD
Folly Beach SC 29439

Perhaps Ron was giving a subtle hint that this was fictitious?

. . . Wayne

LETTERS

Continued from page 11

When the tone returns

The announcement that WWV will no longer use code in transmitting its data again revives the question of why the FCC puts so much stress on code copying ability in its ham licensing.

Nearly all time and frequency standard stations now use voice announcements instead of code. Maybe the change of format by WWV will influence the FCC to join the 20th century, too.

Ernest T. Robarge
Sendestation
684 Lampertheim/Hessen
Wildbahn, Germany

OK EXCHANGE

I teach electrical/electronic/radio and TV mathematics subjects at various levels at County Technical College, Norfolk, England, and I am seeking a one-year teacher exchange with aAmerican teacher. I have been selected on this side, but so far we have been unable to find an American teacher (and family) desirous of working and living in England (but retaining U.S. salary) for a year from August 1972.

If any of your teacher readers (perhaps, but not necessarily, a ham) would be interested in an inexpensive one year "holiday" in England, I invite them to write to me or contact my "exchange manager" WB2FBF who would answer any local query. Official details and application forms in the U.S. are obtainable from the Office of Education, Washington, DC 20202.

Thank you for letting me use your correspondence column for an appeal.

David Lake G3ZCA
County Technical College
Tennyson Ave., King's Lynn
Norfolk, England

HELP

By reading several of your FM articles the past few months I got interested in 2 meters. I'm one of those that never got above 10, and that was about 10 years ago on AM.

I need some help. I picked up a fine VHF base station complete with a coupling shelf for tying to a phone line, etc. It has a decal as being build by Secode in San Francisco. Thanks to International Crystal, they furnished me a couple of crystals to get it on the air. I would like to find someone who could furnish me a schematic on the receiver and possibly the transmitter. The number printed on the receiver is "648-RMR" and transmitter is "649-RMT."

Meanwhile, keep up the good magazine. I enjoy 73 very much and find most articles interesting.

Leon Brandon K5OKZ
8602 Lazy Acre Crc.
Dallas TX 75240

YES, SIR!

I noticed that the July cover of 73 did not show a Texas radio operator's license plate. On the chance that your barn is going without such an *essential* thing as a TEXAS plate, I hereby present you with mine. Show it with pride! Take good care of it . . . I only get two of these QSL cards a year!

Jim Greenwood WA5RCF
2800 Stratford Dr.
Austin TX 78746

Mobile Hint

At different times I have installed mobile units in my cars and have the problem of finding a suitable source of power to operate the unit, so I came up with the following way to do it. Use a length of RG8U, cut it back about 4–5 in., and secure the outside braid to ground and the center conductor to the battery side of the starter relay. Next, drill a ½ in. hole in the fire wall and bring the cable through it. Terminate the coax with an Amphenol SO #239A. On the power leads from the unit, install a PL259. Be sure to get the positive lead to the center of the PL259.

I had no engine noise to bother reception. An in-line filter can be inserted by using two PL259 and two SO239A.

Herb Baumchen WAØWGA
Salina Star Route
Boulder CO 80302

DXpeditions

The Squaw Island DXpedition was one of the finest articles I have seen in 73 for some time. It shows the fellows not only had a lot of fun, but that there is a certain ludicrousness in the "Big DXers" that are sometimes heard.

Sometime I'd like to take a ship of foreign registry, where R&Rs are not too strictly observed, and, within the international waters operate as 5Y3GT (the popular rectifier tube). The weaker the signal the better.

K1YSD's letter duplicates my feelings. It is fine to be a specialist magazine, but that sort of drops out the generalists. I think 73 is at its best when the genius himself is in control. Hope you'll stay at your desk.

Paul Schuett WA6CPP

I would like to draw the attention of the W/VE hams in particular and all hams of the world in general that the statement made in the QST of May 1971 on page 101/102 regarding the VU5KV expedition is not true. Both the VU5KV and the VU9KV expeditions were organized by me and were financed by me and had nothing to do with the Amateur Radio Society of India. This society had arranged only the VU7US expedition mentioned in the QST item. I would like it therefore to be known to all that the ARSI has nothing to do with my expeditions.

It would be wrong for me to comment on the ARSI expedition, as firstly it would not be in good taste, and secondly I cannot say anything about it of my own knowledge. I was busy myself during the entire time keeping the VU9KV station on the air. However I have no doubt whatsoever that the entire ham fraternity would agree with me that the QST has done me an injustice by talking of the VU5KV and the VU7US expeditions in the same breath.

I hope you will publish this in the next issue of your magazine and let the ham fraternity known the correct position.

K Venkataramanan
VU2KV/VU5KV/VU9KV
102 Jorbagh
New Delhi 3, India

73 A PORNO MAG?

You'll probably find this hard to credit but every past copy of 73 has been held here by the customs. They must think it's a porno mag. A lot of my mail from USA and other places never arrives. A certain confrontation has arisen between us. I gave them a bit of a rub in 'ON THE SPOT' – I wish I could put the boot into them properly. Unfortunately we've got a dim and stupid lot in this city. It's not an old gag line – but a mate of mine went to pick up a cake (it had, like my 73, to be opened in their presence). He arrived a little too early – they were eating it for afternoon tea. No doubt my mags are taken home by somebody and read for the pleasure. Sorry to gripe you with this

I must take this opportunity to thank you again, Wayne, for running my short stories. Seems to me they are enjoyed, and I think any technical magazine is made a little more interesting and human by the addition of a little satire or send-up – even if it is a little corny and close to slapstick at times hi. If I can get a laugh I'll send myself up with the greatest of will. Funny how the public never tires of this, and AR is no exception of course.

Recently had a compatriot of yours here in the shack – a journalist – telling me the Americans don't laugh at themselves as well as the English do. Don't know about this, but Phyllis Diller always does a good job on herself hi.

Al Shawsmith VK4SS
35 Whynot St.
West End, Brisbane Q. 4101
Australia

OKLAHOMA

The Annual Texoma Hamarama will be held again this year at Lake Texoma Lodge, Kingston, Oklahoma on October 29–31. Programs for both men and women are planned. There will be technical talks, demonstrations and special interest meetings. Bingo and special entertainment is planned for the ladies. This is a family affair. The annual area meeting of the QCWA has in the past brought oldtimers from surrounding states.

Reservations for accommodations should be sent directly to the Lake Texoma Lodge, Kingston, Oklahoma 73439. All pre-registrations are $2 and should be sent to Texoma Hamarana, P.O. Box 246, Kingston OK 73439, before October 25.

HAMFESTS

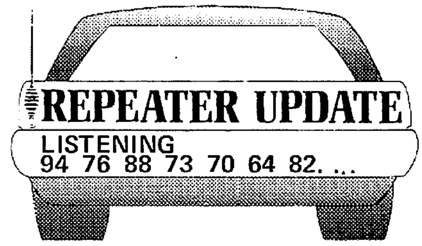
The Monroe County Radio Communications Assoc. will hold their second annual hamfest from 10 a.m. until 4 p.m. on October 10, 1971, at the Monroe County Fairgrounds in Monroe, Michigan. A full day is planned, including prize drawings, contests, and good food. Directions to the hamfest and advance registrations ($1) are available from the Monroe County Radio Communications Association, Box 486, Monroe MI 48161. There will be a talk-in on 146.94 MHz.

PENNSYLVANIA ERIE HAMFEST

The Radio Association of Erie will hold their annual hamfest on October 9, 1971 at 6 p.m. at Sara Coyne Restaurant, 44 Peninsula Road. There will be prizes, guest speakers, and awards. For more information and dinner reservations ($4.50), write to George Dickey K3VLP, at the RAE, Box 844, Erie PA 16512.

TEXAS SWAPFEST

The 17th Annual Brownfield Free Swapfest, sponsored by W5IIPI, Terry County ARC, will be held in the National Guard Armory, Brownfield, Texas, on Oct. 24, 1971. There will be Army MARS and West Texas VHF Clubs meeting. Doors open 7 a.m. local time. Catered Dutch buffet lunch. Eyeball QSO's, refreshments and entertainment, evening of October 23rd for early arrivals. Door prizes. The public is welcome.



ARIZONA

WA5YUT	(Ft. Smith)	34/94

CONNECTICUT

WA1JTB	(Bridgeport)	31/88
WA1KGK	(Trumbull)	22/76
WA1KGD	(New Haven)	11/61
WA1INO	(Avon)	28/88
WA2SUR	(NYC)	19/73
WA1KGR	(Holyoke MA)	34/94
W1BNF	(New Britain)	37/97
WA2UZE	(Huntington NY)	52/76
WA1KGQ	(Vernon-Hartford)	25/79

(alt. 19/79, also 4443.3/448.3 & 52.76/52.525

K1IIG (now WA1INO)
WA1DMX (now WA1KGQ)

FLORIDA

WB4KNQ	(Merritt Isl.)	34/70

(also 443.1/448.1)

ILLINOIS

WB9HWS	(Hinsdale)	22/70

(higher powers can be toned on)

INDIANA

W9INX	(Fort Wayne)	28/88

KANSAS

WAØSNP	(Topeka)	34/94
WAØCJQ	(Salina)	34/94

KØFRA (KC MO, defunct)
WAØOFH (now WAØAMR, KC MO)

MAINE

WA1KGP	(Sanford)	13/73
K1MNS	(Derry NH)	25/76

MASSACHUSETTS

WA1NJR	(Boston)	34/94
WA1NJR	(Boston)	31/91

(Also 31/52.525 & 52.525/91, Touchtone and 440.15/445.15

WA1KGO	(Peterborough NH)	37/73
K1MNS	(Derry NH)	25/76
W1PRI	(Weston)	22/82
W1QFD	(Marlboro)	147.03/87
W1VAK	(Falmouth)	34/94
WA1KGR	(Holyoke)	34/94
WA1KRJ	(Worcester)	37/97
W1MTV	(Westfield)	10/70
WA1NEU	(Pelham)	22/76
WA1KGQ	(Vernon CT)	25/79 19/79
WA1KFZ	(No. Adams)	04/91
K1ZAW	(Beverly)	28/88
W1ABI	(Killington VT)	28/88
WA1KFX	(Mt. Snow VT)	31/88
K1ABR	(Providence RI)	10/70
WA1INO	(Avon CT)	28/88
WA1KGM	(Mt. Ascutney VT)	16/76
WA1KGS	(Waltham)	01/64

(also 444.05/449.05)
WA1KGL (now K1ZAW)
WA1KFY (now W1PRI & W1QFD)
K1ZJH (now WA1KGR)
W1AQJ (now WA1KRJ)

MICHIGAN

WA8BDD	(Clarkston) (was 34/76)	31/85
WB8CQS	(Detroit, GLRA)	34/76
K8VLN	(Detroit, DART)	46/64
WB8CQO	(Toledo OH)	34/76

MISSOURI

WAØVUN	(No. KC)	22/82
WØOKB	(Savannah)	10/94
WØOKB	(secondary)	34/94
WAØAMR	(KC)	34/94
KØOKI	(KC, 448.1/449.1)	
KØOKI	(KC, 52.88/52.525)	

NEW JERSEY

WA2UWC	(Greenbrook)	34/94
WA2UWO	(Fords)	28/76

NEW HAMPSHIRE

W1ALE	(Concord)	34/94
W1KOO	(Mt. Mansfield VT)	34/94
WA1KGP	(Sanford ME)	13/73
K1MNS	(Derry)	25/76
WA1KGO	(Peterborough)	37/73
WA1KGR	(Holyoke MA)	34/94
W1MTV	(Springfield MA)	10/70
WA1NEU	(Pelham MA)	22/76
WA1KGM	(Mt. Ascutney VT)	16/76
W1PRI	(Weston MA)	22/82
W1ABI	(Killington VT)	28/88
WA1KFX	(Mt. Snow VT)	31/88
WA1KFZ	(N Adams MA)	04/91
WA1NJR	(Boston MA)	34/94
WA1NJR	(Boston MA)	31/91

NEW MEXICO

?	(Albuquerque)	16/76
?	"	22/82
?	"	28/88
?	"	40/00

NEW YORK CITY

WA2SUR	(NYC)	19/73
WB2UWC	(Greenbrook NJ)	34/94
WA2YYQ	(Staten Island)	25/88
(RTTY)	(Staten Island)	25/70
W2CVT	(Mt. Beacon)	37/97

NORTH CAROLINA

W4PAR	(Lexington)	31/91

(on 0700–0100; 25 watts)

OKLAHOMA

WA5SJE	(Tulsa)	22/82

(was WA5KWH, now carrier op)

RHODE ISLAND

K1ABR	(Providence)	10/70
W1HQV	(Providence, alt)	10/70
K1OHE	(Bristol CT)	34/94
K1IGF	(Groton CT)	19/94
WA1KGQ	(Vernon CT)	25/79

SOUTH DAKOTA

?	(Brookings)	34/94
?	(Sioux Falls) (1800 Hz)	34/94

TEXAS

W5YNL	Plainview)	22/82 22/94

VIRGINIA

WB4URR	(Blue Mt.)	37/97

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor. . .

COLLINS KWM-Z, 516FZ, W/NB, Waters Q-Multiplier $700.00, 62SI $550.00, 30L1 $350.00, SP600 JX-17 $285.00. Bruce Bouvier, 2609 Finlaw Ave., Pennsauken NJ 08109, 609-662-6575.

WANTED: I. F. Plugin unit complete for Collins R391/URR. K1GVA, 61 Warwick, Portland, Maine 04102.

SELL: Heath SB-620 Scanalyzer, 455 kHz i.f. Perfect condition, $100. Sorry, cannot ship. Write: Don Parmentier, WA6CPM, 737 Golden Oak, Sunnyvale, CA 94086.

TAMPA HAMFEST – Electrical Building Tampa Fair Grounds, Saturday and Sunday, October 16th and 17th. Awards galore. Plenty of free parking. Fun for all. Fully air conditioned.

NEW HAM MAGAZINE: Interested in public service, humanitarian action and international friendship? Sample issue free. Worldradio, 2509 Donner Way, Sacramento, Calif. 95818. WB6AUH.

SWAP: Nikormat FTN. 55 mm 1.2 lens, 250 mm zoom tele, 28 mm wideangle. Strobe, custom case. Mint condx. Want YAESU FRDX & FLDX 400's. WB8FUG. 615-548-7587.

CRYSTALS for Regency, Drake, Varitronics, Standard, Galaxy, Tempo FM transceivers and police receivers. Receive – $4.50, Transmit – $5.50, postpaid. Crystals for all applications available – WRITE! Quick Delivery. Derrick Electronics, Box 457, Broken Arrow, Oklahoma, 74012.

CANADIANS, All makes of Japanese Equipment, with LOW, LOW prices. FREE Illustrated Catalogue. Glenwood Trading Co., Dept. A, 4819 Skyline Dr., North Vancouver, B.C.

SWAN 350-C TRANSCEIVER, 550W SSB/CW/AM with sidetone, calibrator, and 117-XC power supply. Excellent condition, must sell. $275 F.O.B. Denver. Jordan, 7185 South Birch Way, Littleton, Colo. 80122.

TELETYPE PICTURES FOR SALE. Vol 1 $1.00. Vol 2 $2.00. Vol 3 $1.50. All for $4.00. Perforated tapes available. 200 different pictures. W9DGV-C, 2210-30th Street, Rock Island Illinois, 61201.

ELECTRONIC ORGAN full spinet, transistorized, two manual. SASE for particulars. Lloyd G. Hanson, W9YCB, RR2, Box 52A, Angola IN 46703.

GE POCKET MATE. .94/.94 $175; Motorola station monitor T1131A with 80 commercial band crystals $200. Bob Hines, 12914-88th Ave. N. Largo, Fla. 33542, 813-392-8642.

"1971 TESTS-ANSWERS" for FCC First and Second Class License – plus – "Self-Study Ability Test." Proven! $9.95. Satisfaction guaranteed. Command, Box 26348-S, San Francisco 94126.

DRAKE STATION for good price: TR-4 transceiver, RV-4 remote v.f.o., pwr supply and all extras thrown in for buyer; WB2PFY; 212-631-3711; 215-33 23 Road, Bayside NY 11360.

SAROC Seventh Anniversary January 6–9, 1972. Advance Registration $9.00 per person entitles registrant to SAROC Special room rate $12.00 per night plus room tax, single or double occupancy, effective January 4 thru 12, 1972; tickets for admission to technical seminars, HAM RADIO MAGAZINE and SAROC Happy Hour Thursday, SWAN ELECTRONICS and SAROC Social Hour Friday, HY-GAIN/GALAXY ELECTRONICS and SAROC Champagne Party Saturday, Buffet Hunt Breakfast, Sunday. Ladies who register will receive transportation for shopping tour, luncheon and Crazy Hat program at the New Union Plaza Hotel downtown Las Vegas, Saturday. Advance Registration, with Flamingo Hotel mid-night show two drinks, $14.50. Advance Registration, with Flamingo Hotel Dinner Show (entrees Brisket of Beef or Turkey) no drinks, $17.50. Tax and Gratuity included except for room. Frontier Airlines SAROC group flight package planned from Chicago, St. Louis, Omaha, Denver, send for details. Fifth National FM Conference, ARRL, WCARS-7255, WPSS-3952, MARS, meetings and technical sessions scheduled. Accommodations request to Flamingo Hotel, Las Vegas, Nevada, before 15th December. Advance Registration to SAROC, Southern Nevada ARC, Inc., Box 73, Boulder City, Nevada 89005, before 31st December.

EXCITING LISTENING! Police – Fire – Emergency Calls on your broadcast radio, $19.95 up. Also crystals, receivers, scanners, dual/-band. Salch Company, Woodsboro 5, Texas 78393.

RADIO ADVENTURE! Thrill to the amateur radio adventures of Tommy Rockford, K6ATX, in SOS AT MIDNIGHT, CQ GHOST SHIP, DX BRINGS DANGER – all time favorite novels by Walker Tompkins in colorful new editions. Order individually at $2.45 plus 25¢ postage and handling, or all three for only $7.00 postpaid. Utah and California residents add sales tax. Send check or money order to PEREGRINE PUBLISHERS INC., Dept. 73, Box 30565, Santa Barbara, California 93105.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland, Ca. 94607. 451-7755, area code 415.

2-METER FM IC-20, solid state, state of the art, fully Xtaled, w/mike, m-mount, & other accessories. $220. Bob Brunkow, 15112 S.E. 44th. Bellevue, Wa. 98004.

A TRANSFORMER for linear builders. Tapped 115 v.pri.Sec 1050 v at 1 amp. C.T. Can be used in bridge circuit for sweep tube or in a doubler circuit would furnish over 2900 volts at 500 ma. for zero bias triodes. Sealed case. $14.95 plus shipping. Wt. 47 lb. Can be shipped via U.P.S. A.R.C. Sales, 181 E. Wilson Bridge Rd., Worthington, Ohio 43085.

APC-75C 4.6–75MFF CAPACITORS – 5/$1. 5½" x 13" computer boards loaded with parts, rack mount and handle – 2/$1. Catalog 10¢. Trades accepted, any size, write: Electronic Systems, P.O. Box 206, New Egypt, NJ. 08533.

NU SIGMA ALPHA International Amateur Radio Fraternity. Membership now available. Includes wall certificate, I.D. card, newsletter, and more. Send for free brochure. Box 310, Dept. 73, Boston MA 02101.

SIMPSON 2M FM FOR SALE. FCC type accepted, solid state, 5 channels, 8W out, .2μV receiver. T. McLaughlin, WB4NEX, C. Box 622, North Manchester, Indiana 46962.

ELIGIBLE VETERANS build and keep a 25-inch Heath solid state color TV as part of a Bell & Howell (DeVRY) home study course. GI Bill pays 100% of the course and kits costs. Contact Bill Welsh (W6DDB), 234 S. Orchard, Burbank, Calif. 91506.

GALAXY FM-210 w/Power Supply, Mobile Bracket, Three Sets Xtals. Unit has all engineering changes, will not drift. $165.00. P.O. Box J, Lincoln, R.I. 02865.

Wide-Range RF Milliwattmeters Using HCDs

Frank C. Jones W6AJF
850 Donner Ave.
Sonoma CA 95476

The present low price of about one dollar for hot carrier diodes HP2811 or 2800 helped greatly in working out the two rf milliwattmeters shown in the circuits and photographs. They cover the range from audio up to 450 MHz.

A milliwattmeter is extremely useful in checking the output of any transistor or tube oscillator such as those used in transmitters, vfo units, receivers, and VHF converters – providing the oscillator has a 50Ω output connection. A temporary 50Ω output connection can be made to any oscillator, doubler, or tripler tuned circuit by one or more turns of wire around the coil and running the rf output to the milliwattmeter through a short lead of coaxial line. If a measurement at any frequency shows a milliwatt or two into a 50Ω load, one can be reasonably sure of enough rf injection even into a high-impedance mixer. Some FET mixers require about 5 mW injection, so if the measurement into a 50Ω rf milliwattmeter indicates this amount is available, most of the tedious work is done in designing or checking this part of a receiver or transmitter. A vfo frequency control unit may need to have constant output over its whole range. Measurements of rf power over the whole range is needed in this case which may only take a minute or two. The time to iron out vfo irregularities is something else!

The parts needed in a simple rf milliwattmeter are relatively few in number and moderate in cost. The microammeter is used only as a reference indicator so no scale calibration is required. A black line of the meter face cover at the desired 5 or 10 or 15 μA is all that is needed. The rf power calibration is made on the dial or scale of the high resistance variable resistor or potentiometer such as used for af gain controls.

The HP2811 (or 2800) hot carrier diode is remarkably uniform in characteristics from unit to unit. It is also usable with a forward bias dc voltage which greatly increases its sensitivity as a detector. All diodes have a minimum voltage below which the rf current flow is too low to be useful in a microammeter which is a current indicating device. If an ordinary diode has forward bias it may become a good noise generator, or erratic in operation. The diodes used in these rf meters work very efficiently with some forward bias from a small 1.5V battery. The current through the diode is limited by a series resistor of some value between 180 and 200 kΩ. The dc path is completed through the diode and the rf terminating resistor of 50–51Ω. This bias voltage also causes a current to flow through the microammeter, which preferably should be balanced out for low rf power measurements. This current is greatest when the power indicator variable resistor is set to minimum resistance.

By balancing out this current by means of a screwdriver-adjustable potentiometer so the meter reads zero with no rf power input, one reference line on the meter face can be used for any rf power input at any frequency. The dc drain on the battery cell is a value of less than 1 mA when making measurements, but the life of the battery

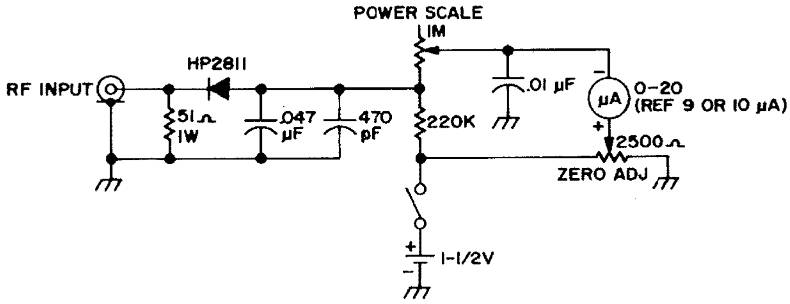
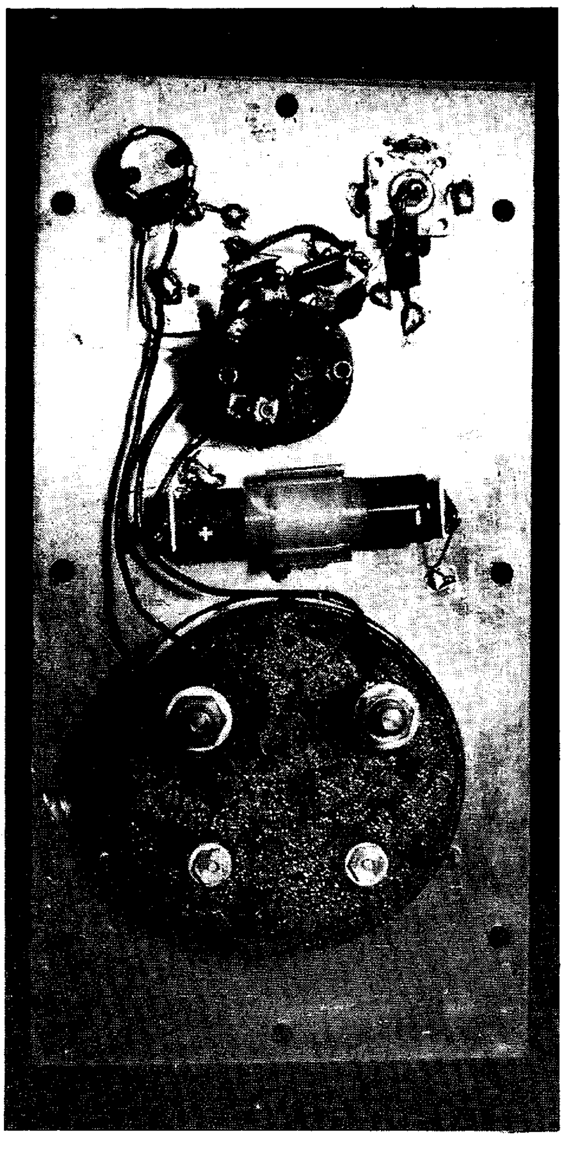


Fig. 1. Schematic diagram of 0.05–500 mW wattmeter.

can be extended greatly by having a switch in this circuit.

The 51Ω 1W resistor (Fig. 1) should be a noninductive, carbon or metallic film type suitable for rf service. Actually a ½W type has a little better rf characteristic but no resistor should be used at full rating. This terminating resistor is soldered across the BNC rf input fitting with as short leads as possible. The diode and its parallel bypass capacitors are also mounted at this input jack. All other components can be mounted anywhere on the 4 x 8 x 2 inch chassis panel (or other sized case if desired).



.05 to 500 milliwattmeter, underside view of completed 4 x 8 board mounting.

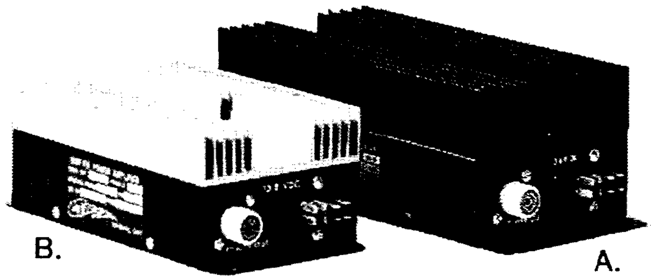
In the other higher range rf meter (Fig. 2), the rf resistor consisted of two resistors in series with short leads across the BNC input jack. A 39Ω 1W and an 11Ω ½W resistor in series make up the 50Ω rf load. The diode is tapped into this resistor in order to keep within the 15 or 20 PIV rating of the HP2900 or 2811 diode. (An HP2800 with its 75 PIV rating could be used across a 50Ω resistor.)

Parallel bypass capacitors were used from diode to ground of the input jack in order to use the instrument over the whole range of 50 kHz to 450 MHz. With even larger bypass values in parallel, the milliwattmeters could be used throughout the audio range as well; amd calibration of the power scale resistor could be made more easily. A sensitive af or low rf voltmeter and an oscillator within the voltmeter frequency range can be used to calibrate the devices. The oscillator needs to have an attenuator, a low impedance output, and a power output of up to 1W for connection to the milliwattmeters through a piece of 50Ω coaxial line. Calibration measurements can be made using the low-power stages of a 450 and 144 MHz transmitter limited to about 500 mW. A series of 3, 6,

More good News from Tempo

THE ALL NEW, TOTALLY UNIQUE, TEMPO CT 220TR FM/AM TRANSCEIVER

Don't let its small size fool you (it's only 7″ wide). This little giant outperforms its big brothers. Look at these specifications... then look at the low price. Completely solid state. 220 to 225 MHz operation. Transmitter: Positions for 5 internal crystals (not supplied). 1 external crystal position and VFO input. Power Output: 4 watts FM, 1½ watts AM. FM internally adjustable to 15 kc. Power Requirements: 13.8 VDC XMT 1.2 amps FM, .5 amp AM, 25 ma Stby. Receiver: Tuning Meter for AM and FM. .6 micro-volt for 20 db quieting. Tunable or pre-set to five internally adjustable frequencies. FM is detected by limiter discriminator, 6 db at 15 kcs. 1 watt audio output — 5% distortion. Double conversion, 10.7 MHz and 455 KHz. ACCESSORIES AVAILABLE: AC Power Supply & Speaker. Internal amplifier to increase output to 20 W FM and 8 W AM. External VFO. External high power amplifiers for FM operation. (CT 220-40 or CT 220-80 suggested.)
Introductory price: $179.00



B. A.

TEMPO CT HIGH POWER VHF 2 METER AMPLIFIERS ...COMPACT AND HANDSOME

A. The CT 1002-2; Operates directly from a 12 VDC power source. Antenna switching is automatic when as little as 1.5 watts of RF drive is applied. The amplifier incorporates Balanced Emitter transistors and state of the art design practices, making it virtually immune to destruction due to high VSWR or misloading conditions. It may be used anywhere in the 2 meter band without the necessity of retuning. Only 9⅜″ x 4″ x 3″, the CT 1002-2 can be installed almost anyplace. Since there are no switches or meters, it may be mounted under a seat, in the trunk or in a desk drawer. SPECIFICATION: Power output: 100W. Input voltage: 13.8VDC. Current required: 12-14 amps. Drive required: 10W. Price: $220.00

B. The CT 602-2: A superior quality 60 watt VHF FM 2 meter power amplifier measuring only 6½″ x 3½″ x 3″. $145.00

TEMPO CT OFFERS THE MOST COMPLETE LINE OF AMPLIFIERS AVAILABLE TODAY

MODEL NUMBER	POWER INPUT	POWER OUTPUT min.	BAND	MODEL NUMBER	POWER INPUT	POWER OUTPUT min.	BAND
CT6-30	1 to 10 W	30 W	6 M	CT252-A2	1 W	25 W	2 M
CT6-60	1 to 10 W	60 W	6 M	CT352-2	8 W	30 W	2 M
CT6-100	1 to 10 W	100 W	6 M	CT220-40	4 W	40 W	220 MHz
CT1202-2	25 W	125 W	2 M	CT220-80	4 W	80 W	220 MHz
CT1002-2	5-10 W	95-100 W	2 M	CT445-1	100 mw to 300 mw	1 W	440 MHz
CT602-2	5-10 W	60 W	2 M	CT445-5	200 mw to 1 W	5 W	440 MHz
CT606-B2	1 W	60 W	2 M	CT445-15	1 to 5 W	15 W	440 MHz
CT452-2	5-10 W	45 W	2 M	CT445-30	1 to 10 W	30 W	440 MHz
CT452-B2	1 W	45 W	2 M	CT445-50	1 to 10 W	60 W	440 MHz

Tempo CT equipment may be obtained from select dealers throughout the U.S. or from:

Henry Radio

11240 W. Olympic Blvd., Los Angeles, Calif. 90064 213/477-6701
931 N. Euclid, Anaheim, Calif. 92801 714/772-9200
Butler, Missouri 64730 816/679-3127

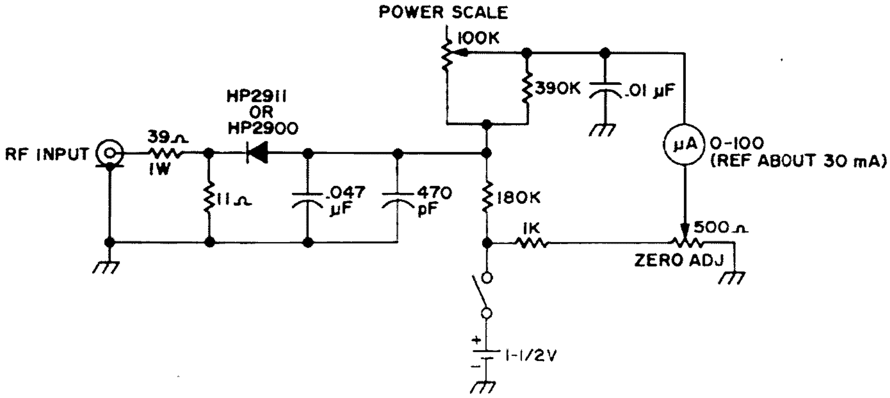


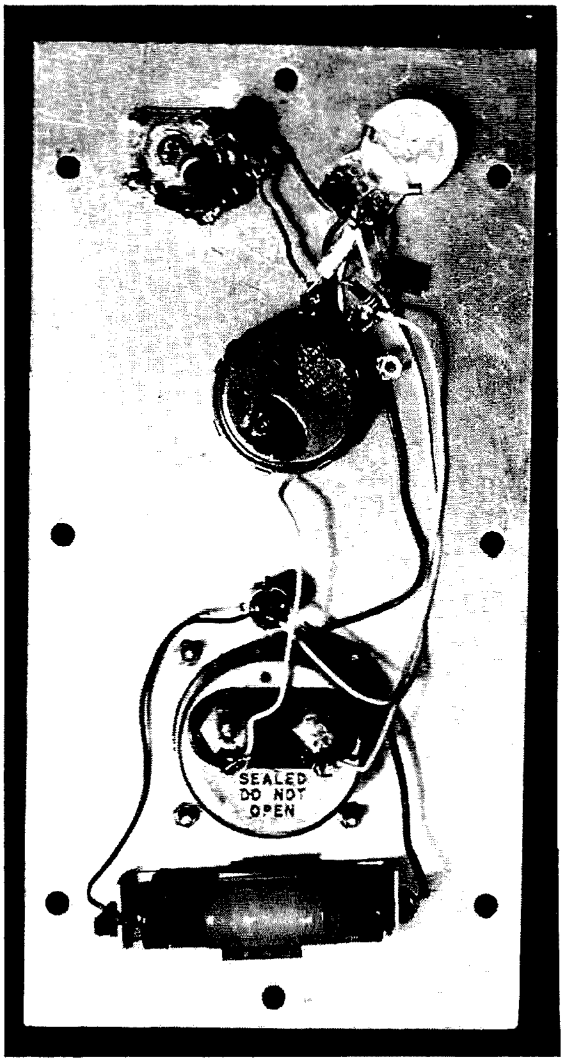
Fig. 2. Schematic of milliwattmeter for measuring rf power levels of 1–1000 mW.

10, and 20 dB resistor pads (1W maximum ratings) with 50Ω impedance values are then cut into the coax line to check calibration points at 144 and at 432 MHz. The maximum errors should be less than 15% and at most frequencies, much less.

The component values shown in Fig. 1 resulted in an instrument having a range of .05 up to 500 mW. The low end of the power range will depend on meter resistance to some extent.

The unit shown in Fig. 2 used a small

1 to 1000 milliwattmeter top view, 4 x 8 x 2 inch case.



1 to 1000 milliwattmeter bottom view.

square microammeter without microampere calibration but the full-scale deflection point seemed to be a little over 100 μA. The reference line of rf power indication was simply a black ink line on the face of the meter. The popular imported 50 μA meters may be used in this same circuit though the higher meter resistance may prevent getting down to less than 0.25 mW readings in the circuit of Fig. 1. The minimum reading of 1 mW up to 1W or the unit in Fig. 2 may be easily obtained with nearly any range of microammeter and "power indicating" resistor. This variable resistor or potentiometer can be nearly any size of af gain control with its maximum resistance either limited by a shunt resistor or by the pot value itself, depending on the range or reference value of the microammeter.

This resistor scale was hand calibrated on an aluminum panel in the higher-range instrument and on a brown Bakelite copper-plated board in the low-range unit.

The zero adjustment circuit of Fig. 2 with a 500Ω pot and a fixed 1000 or 1200Ω resistor makes it an easy matter to zero the meter. Less than 500 mV of bias is needed for the meter circuit. A few microamperes of forward bias current through the diode is enough to enable measurements down to a small fraction of 1 mW.

About 30 different germanium and silicon diodes were tried in these circuits. Even the "fastest" computer diodes were not very good at 450 MHz. These function but at lower efficiency than at HF or VHF – so the power scale error becomes objectionable. The hot carrier diodes were much better.

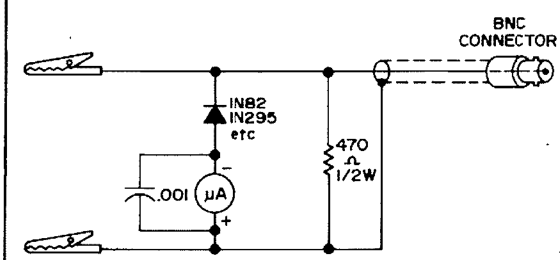
...W6AJF■

STAFF OPENINGS AT 73

We have staff openings for qualified amateurs in the editorial, advertising and circulation departments. 73 is expanding and growing. Perhaps you know of an amateur with experience in one of the above who would like to live in New Hampshire and work on his hobby? Send resumes to 73, Peterborough, N.H. 03458.

OOPS!

We did it yet again . . . actually allowed a mistake to get into print. This time, it was on page 25 of the July issue of 73, in a short article by Walt Pinner WB4MYL, called "Dipper Thing." In some unaccountable way, the schematic accompanying the article was incorrect. At vast expense, we have had it redrawn, and herewith give you the correct version.



Bill Hoisington K1CLL
Far Over Farm
Peterborough NH 03458

Signalling through Space Without Wires

. . . Sir Oliver Lodge before the Royal Institute, London, 1934.

This is *not* another history. It is a list of the remarkable discoveries made in the previous century and left to lie in the dust for some thirty to forty years, or more.

Introduction

The title describes admirably the main effort of all amateurs today. Several decades before the turn of the century, however, these "Maxwellian" waves, or "Hertzian" waves as they were called after the famous German experiments of 1887–1889, made themselves known and were recorded in various publications and letters of the times, as effects, nuisances, phenomena, etc. Note that this was in the decades *before* Hertz.

Any of a number of people *could* have had electromagnetic radiation named after themselves instead of Hertz! All they needed was a little more persistence and a little more long-time research in the face of criticism and ridicule. Of course, that isn't always easy. Sir Oliver Lodge was one of these, and admits several times later his regret at not having followed up certain experiments which showed him the existence of such waves at least a decade before Hertz.

A Civil War engineer signaled 11 miles using electromagnetic waves in the 1860s. Certain patents were taken out, and many people encountered these "unexplainable effects," all before 1887. Some of these are well recorded, such as those taken from Lodge's book whose title is the heading of this article.

An American named Henry was prominent during the period of 1850. He at least got his name perpetuated. He magnetized a steel needle at 30 yards.

It is important to remember that most of the famous names in science of those days in various countries were expert chemists, opticians, astronomers, glass blowers, and metal workers, as well as scientists. They had to be! No technicians were around to do those odd jobs.

Working myself in this field (radio) since 1921, it was my privilege to experience the "rediscovery" of many electromagnetic phenomena through the years preceding and during WW2. Some of these

were high-power microwave pulses, cavities, highly directional beams from parabolic reflectors, powdered iron cores, plug-in coils, and a host of others. Most of these were more or less discarded in the rush for better methods of *frequency* separation from about 1900 on. Not until WW2 threatened did England really push microwaves and radar, which encouraged and promoted a resurgence of pulses, parabolic reflectors, etc. Let us look at this list, which to a great extent reads backwards in time as the "rediscovery" takes place.

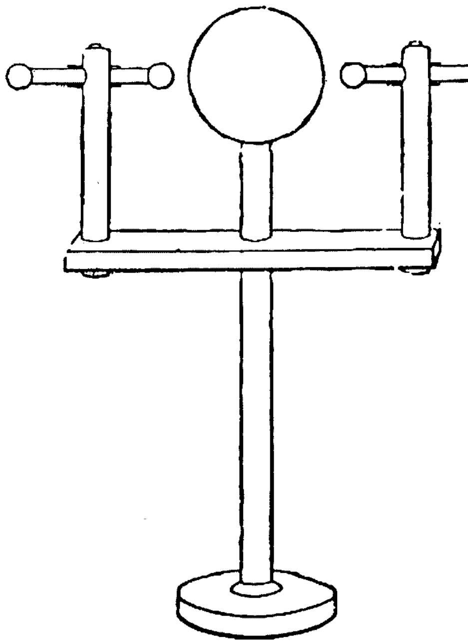


Fig. 1. Lodge's spherical antenna.

The spherical radiator

In 1890 considerable use was made of the spherical radiator. This was first used by Lodge, I believe, improved by Professor Righi of Bologna, and adopted later by Marconi. It is shown on page 25, and Fig. 1 is a reproduction of this "antenna." High voltage was applied to the side spark balls and these discharged over to the spherical radiator which then accumulated a positive wave on one side and a negative wave on the other. This distribution of energy on a sphere, which obviously could not be maintained there for more time than it takes a wave to travel to the midpoint, or equator, was then radiated into space in the form of a very highly "damped wave" (as it was called in those days).

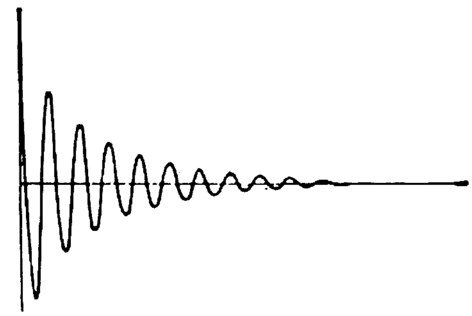


Fig. 2. Highly damped wave.

Page references here are from Lodge's book and lecture of 1894 before the Royal Institute, in London, from which book I have borrowed the title of this article.

Lodge said, page 3, "If the body receiving these waves has its natural or free vibrations violently damped, so that when left to itself it speedily returns to rest, (our Fig. 2) then it can respond fully to notes of any pitch." In other words it is so loaded that it has an extremely large bandwidth. The "bandwidth" of a sphere is actually so large that it becomes almost meaningless to speak of it in terms of frequency.

The contrary, or sharp tuning, is described as follows, "If, on the other hand, the receiving body (antenna) has a persistent period of vibration, continuing in motion long after it is left to itself, great accuracy of tuning is necessary . . . ."

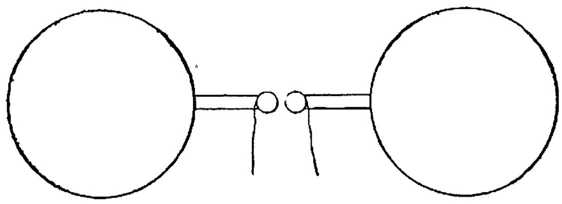


Fig. 3. Standard Hertz radiator producing the wave of Fig. 2.

Antenna radiation versus "Q".

A "standard Hertz radiator" is shown in Fig. 3. Here's what Lodge said about it: "In consequence of its radiation of energy, its vibrations are rapidly damped, and it only gives some three or four good strong swings." For the 1 in. spark balls sometimes used then, this corresponds roughly to frequencies near 5 GHz and pulse lengths of the order of 1 ns.

These lads were very well aware of the

short amount of time involved, but they had not yet invented radar!

High power

Giving his demonstration at the Royal Institute in London, Lodge said of radiation, "Here is a great one, giving waves of 30 meters long (10 MHz) radiating while it lasts with an activity of 100 hp, and making 10,000,000 complete electric vibrations per second. Its great radiating power damps it down very rapidly so that it does not make more than two or three swings." He had demonstrated a 700 kW pulse of 0.2–0.3 usec – and he knew it!

Cavity oscillators

Lodge also discovered cavity oscillators. He said, "A hollow cylinder . . . (is) a feeble radiator, but a persistent one." His figure in his own book is followed by the description, "emitting three-inch waves." Well, 3 in. equals 7.5 cm – and that is some 4 GHz (4000 MHz). Not bad for 1894!

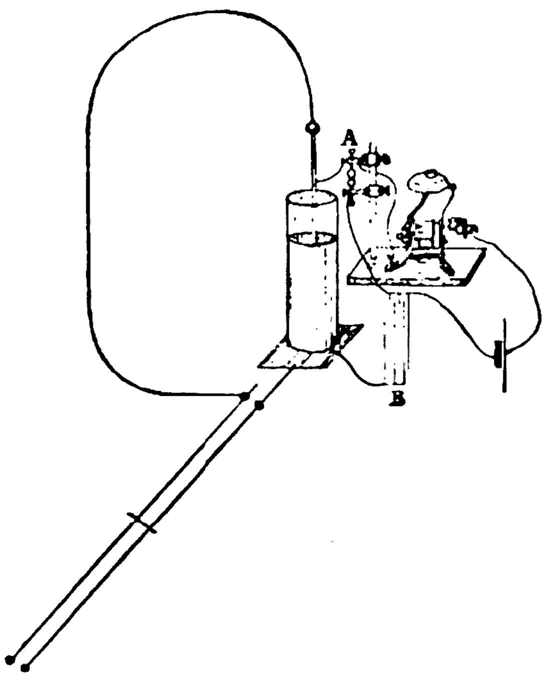


Fig. 4. Lodge's tuned lines and receiving gear.

Tuned lines

Lodge's tuned lines are shown in Fig. 4. The coherer detector and bell ringer are also shown, but enough has been said in histories about those. These tuned lines were quite the rage in the good old 5 and 2½ meter days before the war, which era was some 40 years later!

DX

In describing some of his earlier experiments, Lodge noted, "Signals were obtained across the full width of the college quadrangle, and later with larger apparatus, between the college tower and another high building half a mile away." I consider a ½ mile to be good DX for a coherer. No tubes, no amplifier!

UHF Bow-Tie Antennas

Our Fig. 5 shows Lodge's "bow-tie" antenna, a style that never went out. There are thousands of these all over the country now. They receive UHF TV, some 70 years later!

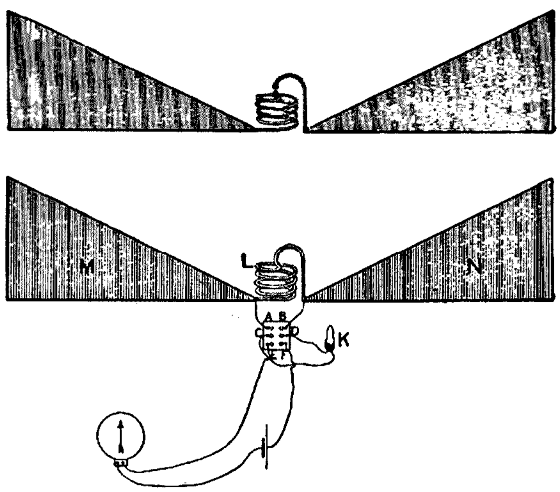


Fig. 5. Early "bow-tie" antenna.

QRM

I found nothing that could be called QRM (how could there be, nobody else was on the air!) but, while he was operating a very sensitive coherer and galvanometer assembly as a detector, he noted ". . . a sensitive coherer in an outside shed unprotected by the thick walls of a substantial building cannot be kept quiet for long."

Completely shielded receiver

To anyone with visions of catwhisker detectors spread out bare on the kitchen table, I can only say, that was *much later*. Lodge knew a lot more about what he was

doing, as you can see: "If a coherer is shut up in a complete metallic enclosure, waves cannot get to it . . . Clamping a copper flange in six places was not enough." He *really* must have had a sensitive detector. And a 0–1 μA meter maybe.

Other Technological Firsts

Microwave, prisms and lenses, cavity detectors, and oscillators (from Lodge's book) are all shown in Fig. 6. Little comment is needed on this list other than to say that most of these microwave items were left to lie mainly unused afterwards for some 35 to 40 years!

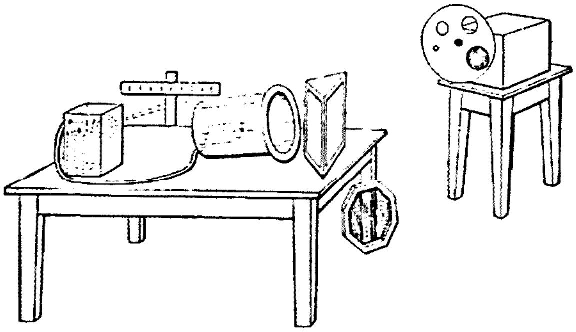


Fig. 6. Early UHF gear.

As to why they should have lain "in the attic" all this time, that is another story. A scientist of those days had a tradition of separation from "mundane" affairs to maintain. This gave Marconi the chance to grab hold of things, which he did without hesitation.

In Marconi's day, the big and expensive battleships and ocean liners were sailing the high seas with absolutely no communications of any kind! It's hard to imagine, but fact. So of course this was one of the first applications to develop, and one which of course set a premium on *long distance*. Not line-of-sight microwaves. This soon led to the use of low frequencies, as signals crackled across the Atlantic, just after the turn of the century.

Lens antennas

Lodge described the power gain of a lens antenna: "An ordinary 9 in. glass lens is next placed near the source, and by means of a light taper (candle) it is focused between source and receiver. The lens is seen to *increase* the effect by *concentrating* the electric radiation." *This* one I use myself in an X-band reproduction of the human eye. Incidentally, I have been at this little invention since 1951 and nobody, but just *nobody*, believes you can see via microwaves – even though a lens antenna *does* furnish a real, exact image on a microwave retina placed on the curved focal plane in back of the lens!

Marconi Learns About "Wireless Telegraphy"

Who learned from whom? Well, Lodge started the ball rolling. He said, "In Italy, the work described in the lecture became well known, and the subject was developed largely, especially by Prof. Righi, of Bologna . . . It appears that it was from him that Signor Marconi learned about the subject and immediately conceived the idea of applying it to commercial telegraphy." He also followed up the idea! And I should think he did learn from Prof. Righi, since this learned gentleman was Marconi's teacher!

Powdered iron cores

I remember well my own first sight of a powdered iron core. It was in Paris, where I had a small factory making radios. The year was 1933, and considerable interest was stirred by an "iron core" for a radio coil. But Lodge was there first! Speaking of cores inside coils, he found that the conductivity of massive iron makes an "unsuitable substance," and instead used a mixture of iron filings "chemically reduced." He also uses the words "chemically obtained" and "iron powder with paraffin."

A Recent "Overlooked" Discovery

An engineer at GE named North was working on *welded* (junctions?) microwave crystal detectors during the war, and appears to have made some which oscillated under certain conditions of bias. However, oscillation in a 30 MHz i-f strip was not desired at that time, and this early diode (transistor) oscillator was only revived in the 1950s.

Perhaps there are still some engineers around who can tell us more about *this* item.

K1CLL■

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An Instant FM Repeater For EMERGENCY USE

Most repeaters are fairly complicated affairs which take a lot of time to plan and build. Very often, though, a portable repeater which could be set up almost on a moment's notice may come in handy. This might happen in an emergency when the area needing coverage has no regular repeater or when the regular repeater has been damaged; it could also happen when a special event, like a road rally or exhibition, is planned and a repeater is needed to extend coverage. Here is an idea for an instant FM repeater which can be set up in a few minutes, moved anywhere needed (as long as there is a road leading to the site) and dismantled just as easily. And, in a pinch, one man can carry it up the hill.

Figure 1 shows the complete diagram of the control unit; hook it up to any two mobile FM transceivers, and a complete repeater is in operation. All it does is to key up one transceiver when the other one receives a modulated signal. In emergency operation, two mobiles meet on top of a hill, connect the control unit between their two mobile rigs, and they're on the air. The repeater does not have any time-out timers, no logging, and none of the other fancy control gimmicks needed for full-time operation, but it will repeat and repeat well.

As shown in Fig. 1, the audio signal from the receiving transceiver is connected to the audio input. To make sure that no connection other than audio is needed, the control panel operates on the presence of audio. The audio input comes directly from the speaker; most small transceivers have the speaker leads brought to a connector on the rear, in which case only a plug is needed. Otherwise, a clip-lead connection to the speaker terminals will do.

The audio signal is applied to two 1 kΩ potentiometers. The audio level pot controls the volume which is applied to the mike input on the transmitting transceiver. It's only necessary to adjust the volume so that the modulation sounds right.

The audio is also picked off the trigger level pot, and amplified by transistor Q1. It is then sent to the base of Q2. Because Q2 has no base bias, it is normally cut off so that the collector of Q2 is around 12V. But when audio appears, the signal on the base of Q2 turns it on very quickly, and the 150 μF capacitor charges to 12V. This applies base bias to transistor Q3, which in turn operates the relay. When the last bit of audio disappears, the capacitor takes about 1 second to discharge and release the relay.

In normal operation, with no received signal, the squelch on the receiver keeps the audio off, and the relay in the control unit is not energized. As soon as a signal is

received, the squelch opens and the audio is applied to the control unit. The relay then closes and stays closed until about 1 to 2 seconds after the last audio has come in. The delay is long enough that the relay stays closed even between words and sentences. (The use of audio instead of a squelch voltage would not be good for a permanent repeater, but for emergency operation it has the advantage of working with any receiver.)

When building the control unit, make sure to bypass all leads going into the unit. The circuit should be built into a tight shielded minibox or other enclosure, with twisted lampcord without any hum pickup. But rf shielding is important where the leads enter the control unit to prevent false triggering.

While waiting for that emergency to develop, this control unit can be used for other tasks as well – here are just a few suggestions. If you like to "read the mail" on your FM channel, why not hook it up between your transceiver and a tape recorder. Whenever a signal appears, the recorder will turn on and record. It's great for knowing what goes on without sitting around waiting for something to happen. The input can also come from a monitor

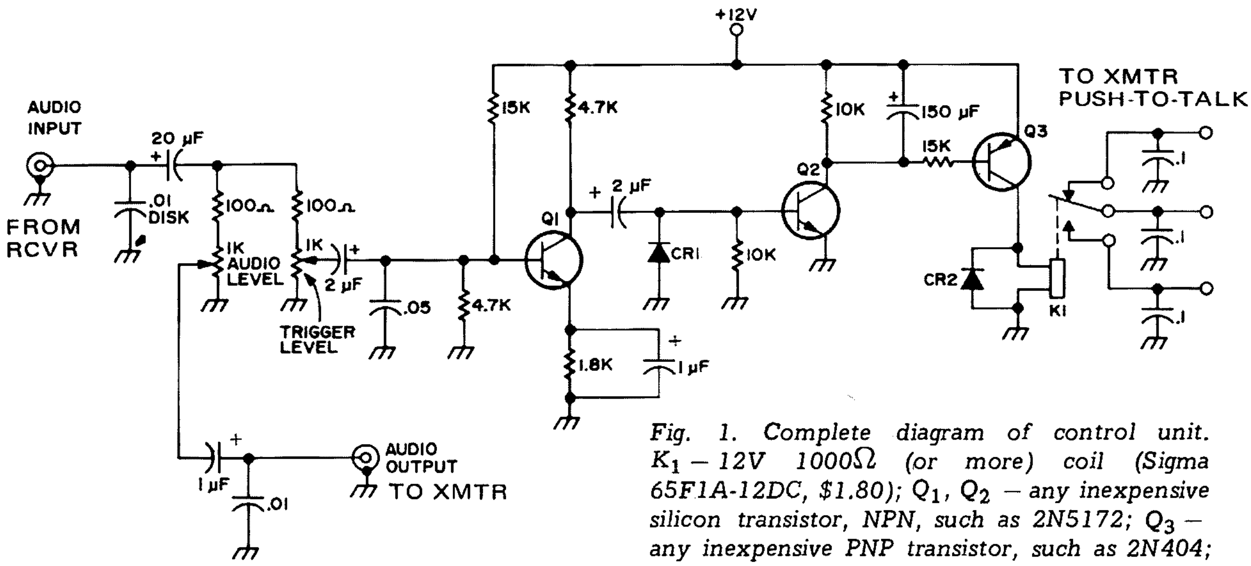

Fig. 1. Complete diagram of control unit. K_1 – 12V 1000Ω (or more) coil (Sigma 65F1A-12DC, \$1.80); Q_1, Q_2 – any inexpensive silicon transistor, NPN, such as 2N5172; Q_3 – any inexpensive PNP transistor, such as 2N404; capacitors – all ceramic or electrolytic (15V rating or higher); resistors – ¼W or ½W; CR_1, CR_2 – any small germanium or silicon diode.

all input and output leads bypassed (feedthrough capacitors are just fine). The idea is to keep the transmitted rf from getting into the box and causing false triggering. The battery can be built-in too, since the current gain is only 2 mA during wait periods, and reaches only about 10 mA during transmit, depending on the current drain of the relay. The higher the coil resistance, the better for the battery.

Desensing is not as much of a problem as might appear, since the two mobiles can easily be positioned several hundred feet apart. The control unit should be located next to the transmitting unit, to keep the switching and mike leads short; the speaker leads are at a low impedance and can be receiver or from a receiver strip; the important thing is that the receiver have a squelch circuit to cut off the audio when there is no signal.

Another cute application is to connect the control unit between a telephone line and a tape recorder. That way, any call on the line will be recorded. Or it can be connected between the telephone and a small transmitter. Or between a room mike and a tape recorder. In these cases some additional amplification or isolation from the phone line may be needed, but this is fairly straightforward.

Whatever you do with it, it's a handy thing to have around.

. . .K2OAW■

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IT' It's The Real Thing

Power supplies are necessities to every ham, but most hams hesitate to buy one. They would rather build it since it's cheaper that way. It's just a bit of wiring and drilling – so why not?

Some hams dive into their junkbox and design a supply, depending on what parts they have. Others take a look at various "73" issues and build it accordingly, for after all, there are lots of versions in "73." Some authors emphasize low cost, others good regulation. Some are simply versatile and can be used for everything. And then, of course, there are the transformerless ones (for those who really ask for TVI).

By now I have built quite a few supplies, from "low cost" to "versatile," the fancy regulated swinging choke types, and made 600V from the 115 ac line. (Always kept my eye on the dollar bills.)

I copied guy "A's" low-cost supply, using two TV transformers because they were in my junkbox. My 300V B+ turned out to be 400V, unfortunately. And after I blew my 1 kV diode-bridge across the 700V CT winding, I ended up with 1.1 kV on the 900V rated electrolytics. They lasted anyhow. At 200 mA load current, the transformer got red hot. However, it kept my transmitter going, using both 6.3V heater windings.

Equipment changes required a new supply. SSB was on the list, so I bought a swinging choke for $13, a new, bigger chassis and a heavier heavy-duty TV transformer. This one had 600V ac only. Using the choke input circuit, I ended up with 650V dc only, which was a little low. I added a small 120V/500 mA job at the back of the chassis and put it in series with the TV transformer, and there I was with a beautiful 780V dc. Voltage hardly changed from *no load* to *full load*. The only trouble was that the bleeders heated up the chassis with 22W – but who cares – it cut down on fuel oil bills, hi. Well, it worked just fine. It was big, of course, and when I added up dollars and cents, it wasn't that cheap at all (but lots of little expenses don't hurt as much).

Time passed and equipment changed. I sold the whole monster with transmitter and everything. The rig ended up as a CW transmitter anyhow. That can happen with a lack of spare time, you know. But now comes the real thing: I had three month's time until I got my commercial rig, so I made a universal supply. It had any supply voltage that could possibly pop up in any piece of equipment, so I didn't rush. Thought I'd do it "proper" now, with an everlasting supply. Looking into friends' junkboxes – my own was empty – I ended up with a beauty. Put two 800V supplies in series (this gives 1.6 kV – I had that future kW in mind). I must admit, 2 kV looks more like it, but then . . .

To make a long story short, it was not the real thing. Now I've had it. I'm fed up. No more of those cheap, ultraregulated general-purpose supplies. They are bulky,

ugly, and not cheap at all.

Looking around, I noticed that average requirements for transmitters and transceivers are as follows:

700–800V dc @ 250 mA
275–300V dc @ 200 mA
–100V dc @ 10 mA
12.6V ac or 6.3V ac at 6 or 12A

So why not just buy a single transformer that does the job? I know, they are hard to come by. So I checked with a local transformer manufacturer and was surprised at the cost of it: only $24 for

300V ac @ 500 mA
480V ac @ 200 mA with centertap and taps at 70V from CT
12.6V ac @ 6A with centertap

the power amplifier. There you are! Do I hear remarks on the regulation? Okay, let's see. The 300V B+ is constantly loaded with 150 mA or so; therefore no regulation is required. The high voltage reads 840V no-load – 725V loaded with 200 mA. In SSB mode, where regulation is important, idle current is about 120 mA, and the voltage reads 760V, then. Peak current in SSB mode reaches, say, 400 mA, at which the voltage decreases to 700V at the most. Regulation therefore is –9%, and that's not bad, eh? For the CW man regulation is much worse; it is –20%. Looks bad, but you ain't gonna hear that unless it pulls your oscillator, which it shouldn't, anyway.

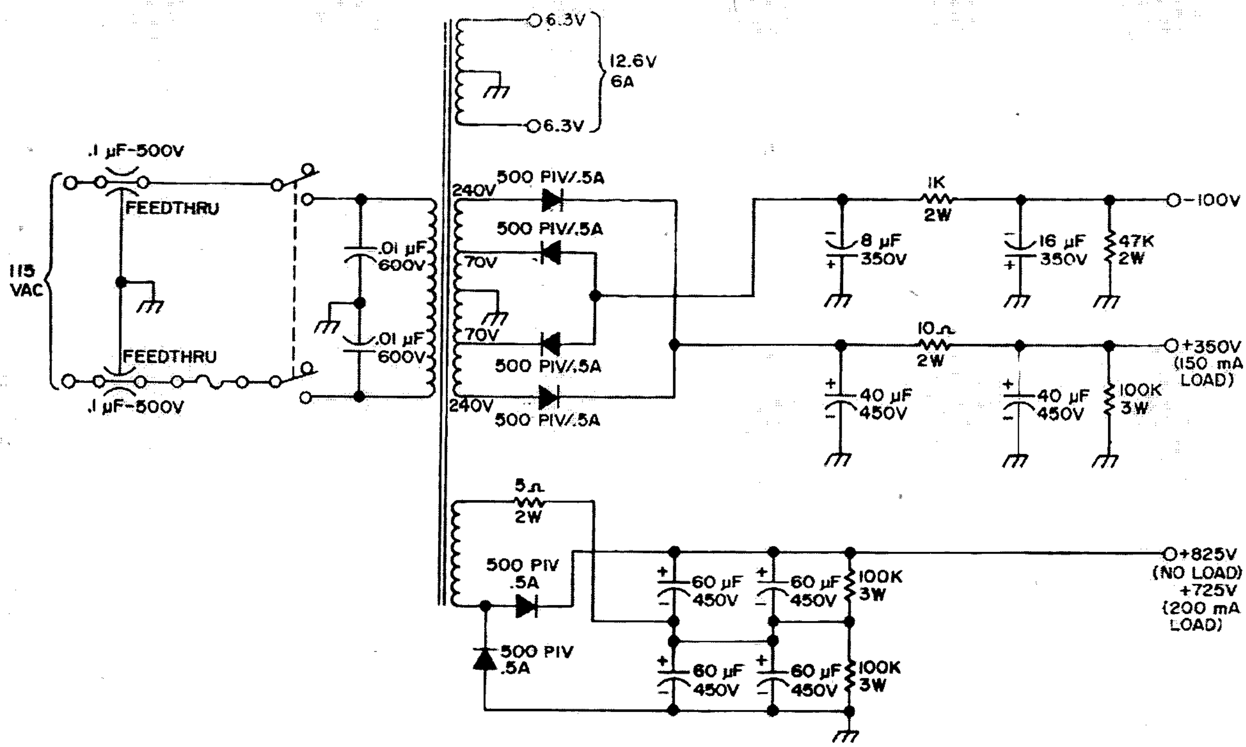

Fig. 1. Schematic of the suggested power supply.

Now look what you can do with it: There is all the filament power and versatility you could possibly need – 6.3V or 12.6V. You can get 300V dc out of it with two cheap 500 PIV diodes; –100V dc out by using two cheap 300 PIV diodes; make a full wave voltage doubler with two cheap 500 PIV diodes to get your high voltage for

So listen, if you build that cheap or else power supply for your rig, figure it twice, don't buy two heavy-duty TV transformers – buy the real thing. While you break even on the transformer costs, you save money on a smaller chassis and low-cost diodes.

. . .VE3GSP■

METEOR SHOWERS: ON PREDICTION ACCURACY

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In the *VHF Handbook,* a table of meteor shower data includes information that relates to the relative speed of the shower particles as they enter the earth's ionosphere. What this says, in effect, is that not all particles enter the E layer at the same speed. In each case the particle entry speed is related to the relative position (and movement) of the earth and the particles. For example, a particle that enters the earth's ionosphere head-on will contact the E layer with much greater speed than a particle that must come up from behind and overtake the earth. In between these two extremes are particles that come at the earth from various tilted trajectories, where the combined speed of the earth and the particle may add to or subtract from the actual apparent speed of the particle.

One of the most important factors in determining at what height a particle heats up by friction and ignites a trail behind it is the speed at which it enters the E layer. The faster the particle's apparent speed, the quicker it heats to ignition in the layer. And the higher up in the layer that ignition occurs, the greater the skip distance possible, since skip distance is directly a function of the height of the refraction point.

A meteor *shower* is so named because an unusually large concentration of meteor particles entering the E layer during the shower period appear to come from the same region in space and at the same speed. Thus, during the annual Geminids shower in December there is a reported average particle speed of 35 km/sec. Because of the approach trajectory of the shower particles, we know that this shower is basically best for the north–south paths (because the particle trajectory enters the E layer along a basic north–south path). Because the speed is relatively slow (35 km/sec), the particles penetrate well into the E layer before the slightly denser lower portions of the E layer build the particle skin temperature high enough to cause ignition.

With the ignition point occurring *low* in the E layer, the skip distances covered during the Geminds are generally *short*

(500–900 miles), because the refraction point (where the ionized column forms) is itself low in the layer.

On the other hand, the annual Arietids shower, peaking during the daylight hours on June 8, is a *fast* particle-speed event (70 km/sec). Here the particles tend to ignite *higher* in the E layer, and the distances covered are therefore generally from 900 to 1300 miles.

This becomes a most important factor in planning schedules on 144 MHz, since a great deal of time can be wasted looking for the wrong distances during the wrong shower.

The Right Direction

Over the years the table now appearing in the VHF Handbook (originally appearing in the April 1957 issue of QST) has been subject to some discredit by otherwise enthusiastic VHF meteor chasers. Actually, the table is quite accurate. What requires further refinement is the annual changes in the nature of these meteor shower events, and some explanation as to how the Optimum Paths/Times portion of the table was initially arrived at.

Anyone who has observed meteor propagation over the years recognizes that no given shower (not even the annual big daddy, the *August Perseids*) acts exactly the same every year. Since most meteor showers result from the crossing of paths the two paths do not cross at exactly the same point in space two years in a row. Most meteor showers are the result of long dead comets, where the debris remains in the same general solar orbit. Within the comet-left debris region, the distribution of the space particles is anything but uniform.

This table shows visual meteors as counted by the American Meteor Society. Its parallel to VHF radio meteors, as a general level of activity, has been verified by the author as "quite accurate." As a matter of practical concern, these sightings were taken between 3 and 4 a.m. standard time, but dovetail closely with the 5–7 a.m. radio meteor period. Counts under 20 are considered below par; 20–30 average to above; 30 and up are in the shower category (per-hour count).

Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	19	24	12	10	13	14	9	37	10	10	15	22
2	33	3	8	9	14	6	16	32	18	12	16	18
3	30	21	5	12	19	8	21	22	15	18	23	30
4	20	16	13	5	19	10	15	32	10	19	17	19
5	17	16	5	7	18	4	26	14	23	17	11	18
6	16	16	14	4	19	9	14	20	22	15	12	19
7	16	4	11	9	18	8	21	21	19	18	17	36
8	17	10	10	5	15	13	19	35	16	20	10	18
9	25	11	14	12	18	16	32	33	14	17	15	12
10	20	12	11	21	12	21	18	42	14	12	11	29
11	14	12	11	8	15	17	22	66	34	23	19	25
12	26	11	12	11	26	13	13	39	22	18	15	83
13	19	19	13	20	21	20	20	32	10	20	14	44
14	12	13	26	8	9	7	35	29	13	17	21	30
15	11	13	11	10	10	19	9	17	13	21	25	18
16	20	9	5	9	13	17	24	16	28	20	20	23
17	16	3	11	7	12	16	22	16	13	20	15	18
19	12	20	8	7	11	14	13	19	19	24	3	22
20	16	15	8	10	12	31	23	24	18	25	13	17
21	19	15	10	14	12	13	14	22	25	41	31	16
22	17	15	12	14	13	23	33	33	25	25	28	7
23	12	15	6	9	13	40	17	24	21	25	19	27
24	12	15	2	6	14	5	36	11	20	19	15	16
25	14	9	8	14	20	9	31	21	19	17	17	23
26	12	12	6	8	14	12	34	22	17	22	19	16
27	10	16	8	11	21	22	24	24	27	28	21	28
28	14	8	5	14	9	20	28	23	15	22	16	15
29	16	15	1	13	7	14	23	17	10	10	30	19
30	20		12	10	28	18	29	20	11	22	15	25
31	14		11		21		30	15		22		11

Since the particles are typically too small to observe from earth, we can only gage their intensity by the precipitation of particles into our E layer, where radio and visual sightings are made of their ignition trajectories.

If there are cyclic measurable patterns to the annual intensity of their returns, we haven't been around to observe long enough to find them.

The matter of best-time/best-path is a slightly different problem. The best-time predictions are based upon observations over the 20 years or so preceding the original 1957 appearance of the table. Within the confines of the total number of hours in a year, and the fact that no two years in a row do we end up at the same exact spot in (relative) space with the meteor shower, these times are quite accurate.

The *best-path* predictions are apparently the most subject to scorn by active year-after-year VHF meteor men. Some merely suggest you ignore these portions of the table and schedule random directions within the best time periods.

The problem may be this: The path predictions are based upon the trajectories of the particles within the meteor swarm that is called a shower. These trajectories do not change, measurably, from year to year. However, the table is based upon the *assumption* that all of the particles within the known trajectory will fall into the E layer *on their trajectory.*

Particle skipping could account for the apparent discrepancies in projected trajectories/best paths. We know the initial approach to the earth is relatively fixed. What we question is the through-the-ionosphere trajectory, which results in the placement of our ionized column, and the resulting refraction from the column that occurs.

Amateur contribution in this realm can be significant, if sufficent numbers of 2 meter meteor-shower chasers work to find the real trajectories, based upon the paths that produce the best signals during a shower where published data seems inaccurate.

. . . W5KHT■

Simple Digital Remote Control Circuits

Jim Ashe W1EZT

Do you want to solve a remote-control problem without getting into far-out complexity and expenses? You can easily apply a few key concepts used in sophisticated computers and industrial control systems to work out a system requiring a minimum number of parts. And if you have cost and availability problems the system can be arranged to accept almost anything of a generally appropriate nature.

For instance, if you are interested in hi-fi work a single length of common 4-wire TV control cable can be run where ever convenient to switch up to eight remote circuits. The circuits don't have to be all in the same chassis or even in the same building, if you have ambitious ideas. And the switching scheme can be extended to sixteen circuits by adding one wire to the control cable.

Short-wave listeners and ham radio operators can use the same methods for remote tuning of antennas. If you have a reactive antenna far from your ham shack you can easily tune it to any of eight frequencies by switching in capacitors or inductors; or a similar arrangement can be used to run a single transmission line out to your antenna farm where you can switch it in to any of several antennas. Let's look into an idea very popular in computer science.

Digital coding

When we are switching circuits, we do not usually expect the switching operation to take place by gradual degrees. We want the switch hard *on* or hard *off,* full in or full out. A capacitor is an active part of the circuit or else hopefully does not influence the circuit at all. Sometimes we use continuous remote control tuning systems or gain-control arrangements, but these require elaborate provisions to guarantee adjustment to the proper setting. A system will be very much simpler if the only adjustments are yes-no, on-off switching operations.

There is a number system that works in this way, and we can hold this system against our switching circuit requirements to discover they correspond exactly. We call this the binary number system. See **Fig. 1.** From right-to-left the first digit is either a zero or a one, the second a zero or a two-value, the third a zero or a four-value, and so on. In using this system we remember

16 VALUE	8 VALUE	4 VALUE	2 VALUE	1 VALUE		DECIMAL EQUIVALENT
0	0	0	0	0	=	0
0	0	0	0	1	=	1
0	0	0	1	1	=	2
0	0	0	1	1	=	3
·	·	·	·	·		
·	·	·	·	·		
0	0	1	0	1	=	5
·	·	·	·	·		
·	·	·	·	·		
·	·	·	·	·		
·	·	·	·	·		
1	1	1	1	1	=	31

Fig. 1. How binary place values add up to decimal numbers.

the place values and include them if there is a one in the place, or leave them out if there is not. Binary 101, for example, comes out four plus no two plus one, or five.

Now, when we design our switching system, perhaps we are not too certain which of various possibilities is best. Maybe we think we will switch in a different component for each setting required, as in **Fig. 2.** Is this the simplest arrangement we could find? Probably not, because each component is used only once.

And then we think about adding components one by one, using a switch with a wide sliding contact. See **Fig. 3.** This is very

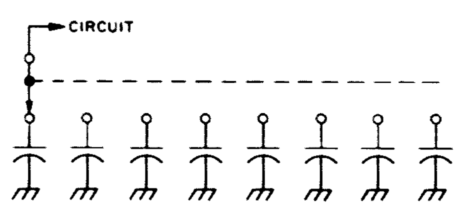


Fig. 2. Eight separate capacitors are needed to make up eight values of capacitance in this simple switching circuit.

like using a variable component such as a tuning capacitor, so we see this scheme has the blessing of antiquity, but it turns out we save no parts at all and add the requirement of a rather special switch. Now let's look at **Fig.** 4, and see what we can do with the binary number system.

Here we have a set of unequally sized values, and a circuit that can switch in none, a few, or all of them according to the definite schedule of the binary number system. Since there are only three components corresponding to three digits of a binary number, we require only three wires to control the switching, plus a ground return lead. This is how we can get eight assorted values using three leads and three relays.

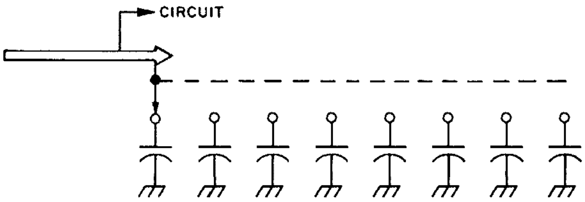


Fig. 3. If we use a continuous shorting switch, we still need eight capacitors, and the switch will cost more than an ordinary selector switch.

If we want to do remote through-switching, as in the case of several antennas fed by one transmission line, or when we want to carry out several remote control functions, the picture is a bit more complex. See **Fig. 11.**

The chain of relays decodes the incoming control signal to determine which of various possible paths is complete. If you have relays with several sets of contacts you can get by with only three relays or you can series and parallel windings to make up the equivalent of multiple-contact relays as required

For remote-control work we can arrange the relays in a simpler way, so that each set of one, two, or three relays will complete a circuit only when its number is fed into the control line. I've worked this out in **Fig. 10.**

You can design systems capable of many more switching or control operations by adding one or two additional wires. I am discussing an eight-value system fed by a 4-wire cable simply because it works out well and is elaborate enough for most purposes. If you want to make something more complex you can try using a multi-wire cable or, if you have an *rf* application the coax outer conductor can serve as a ground return.

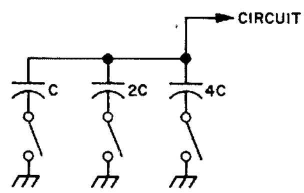
System input switching

How do we set up a system that will apply a voltage, or else no voltage, to each of the control wires according to the pattern of binary arithmetic? There are three ways we can do this.

The simplest is a switch in each line, and if the switch is on, there is voltage applied to the line. We label the switches 1W, 2W and 4W, and the W stands for the term "weight" to remind us we have an additive switching system. If we want a No. 5 control operation at the other end of the circuit we turn on the 1W and the 4W switches. Going to a No. 6 control operation we turn off the 1W switch and turn on the 2W switch. I have diagrammed this in **Fig.** 4 and **Fig. 5.**

Another way we can apply the correct voltages to the control wires is a several-pole several-position rotary switch. There is a pole for each control wire and a position for each control setting as in **Fig. 6.** Rotating the switch feeds the power supply voltage to the appropriate wires in sequence for each control position to convert our front-panel numbers or labels into a binary coded voltage applied to the control cable.

This arrangement is excellent for small systems but it becomes impractical for anything more elaborate than our three-leads-and-return system. We need a three-pole eight-position switch here, and such a switch is probably easy to find.



BINARY SWITCHES CLOSED	CAPACITANCE
000	0
001	C
010	2C
011	3C
100	4C
101	5C
110	6C
111	7C

Fig. 4. Switching capacitors according to the pattern of the binary number system enables us to get eight values of capacitance from three capacitors.

Adding one more control line brings us to finding a four-pole sixteen-position switch, and a five-pole thirty-two position switch would be expensive and very hard to locate. But there is still another way we can do our switching, with a single-pole switch for any number of conductors.

The three-wire and return system is diagrammed in **Fig. 7.** Why have I added the semiconductor diodes? Because without them the circuit would be unable to dis-

criminate between certain control settings. Let's imagine diode D1 is shorted, and we are turning the switch through its positions.

At position 0 no supply voltages are applied anywhere. Going to position 1 relay 1W is energized as it should be, but the voltage also passes back through shorted diode D1. From there it goes forward through D2 to energize relay 2W. We pull out D1 and replace it with a good diode, and in the 1 position only relay 1W can be energized. Looking again at **Fig.** 7 we see that if D7 were shorted a 1 input setting would energize all three relays for a no. 7 control operation.

Adding more available switching positions is merely a matter of sketching out this illustration on a roomy piece of paper and adding lines and diodes. The next line without a diode would be the 8W line, and all the others would get diodes. Reverse diode polarity for a negative supply voltage.

You can use surplus junction diodes in this application, and a simple forward-current/reverse-voltage test will be adequate. These cheap diodes at a penny or a nickel apiece will do well here if you are careful to check them first, since this service is extremely easy on the diodes. A special case I'll touch on later is when you are working with antenna systems that may be struck by lightning. Other diode failure mechanisms are case leakage and poisoning from contaminants already inside the case. If you use surplus diodes do not let your suspicions lapse after a few weeks.

When you are designing your remote switching system, remember your power supply may have to energize several relays for indefinitely long times. Test it at 35% over anticipated maximum load current for a day or two, and if it passes, it will be reliable in normal operation.

In choosing supply voltage allow for voltage losses along the remote control line.

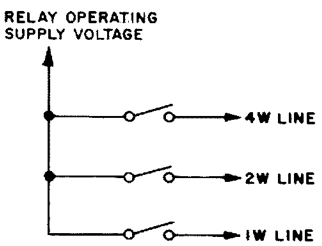


Fig. 5. The simplest way to feed a binary coded control signal into our control cable is to use separate switches and do the adding in our heads.

The relay sees supply voltage less all IR drops along the line, and these depend upon current. Each lead of the 4-wire control line will run about 0.3 ohms per hundred feet for copper, 3 ohms per hundred feet for steel wire, in the No. 20 size. And voltage drop along the ground return lead must be estimated on the assumption this lead is carrying *all* return currents the circuit can develop.

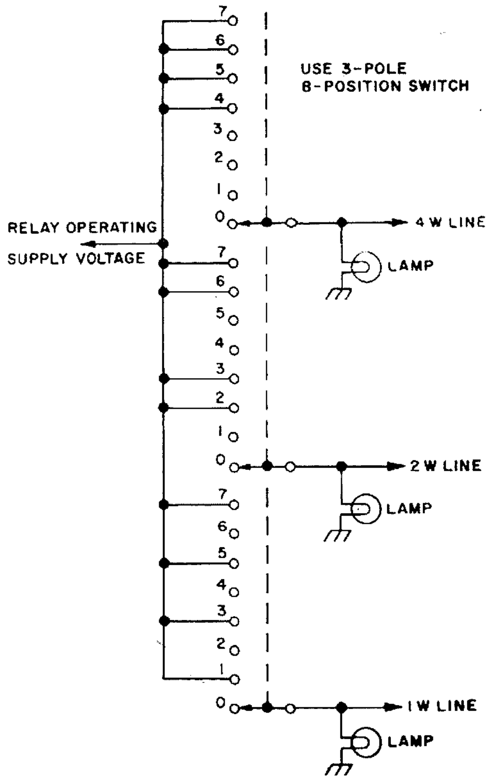


Fig. 6. We will probably need a three-wafer rotary switch for this circuit, which will code the correct voltages into the control cable for each setting. Pilot lamps offer binary readout of the signal applied to the system.

Control cable installation

A few quick passes with a tape measure will give you a good indication of how much control cable is needed for your remote control installation. If the cable could be stretched I'd recommend an eyeball estimate, but in my experience when you come out short you have to splice. Measure, add five or ten percent to the results, and obtain that much cable.

Put paper or cloth tape around the cable wherever you staple it down so that sharp metal edges cannot penetrate the insulation and short wires. There is a lot of TV hardware available for getting the cable through walls and windows, and outlets and other fittings are available from electronics suppliers.

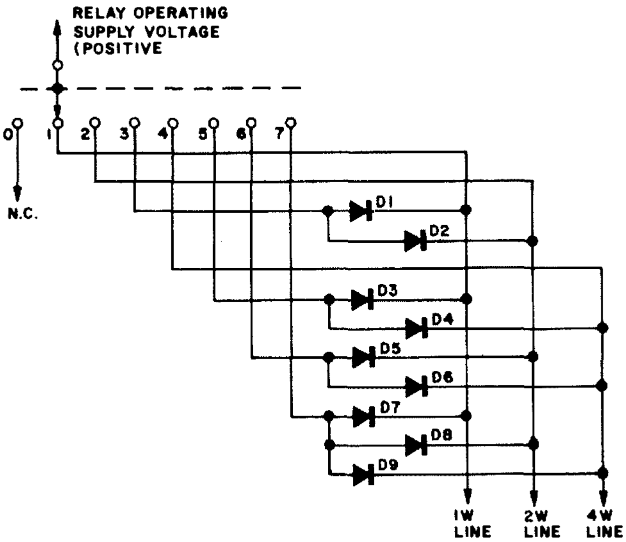


Fig. 7. A more complex circuit enables us to use a simpler switch. This is the way to do it for large systems.

Use mating connectors at control points. It is very inconvenient to have the relay box wired in place when you want to get it over to the bench for alterations or servicing. There should be several inches of slack between the cable and the box for convenience and to eliminate strain on the connector.

The control cable has no business next to power circuits. Keep it and its connectors well away from power outlets and avoid arrangements such that some interconnection could develop. There is a special problem which may appear in very long outdoor cable runs, such as to a remotely controlled antenna.

Good antenna design resembles good lightning rod design. Use correct precautions in bringing control and antenna leads into your house, and there is another protective step you can take to save diodes. See **Fig. 8.**

When lightning strikes nearby there may be a fierce sweeping magnetic field developed. Good design minimizes the amount of energy this couples into your remote control system. See **Fig. 9.** The wires to the tower are twisted around each other to minimize open space between the conductors, and so that induced currents in different parts of the system flow in opposite directions and average to near zero.

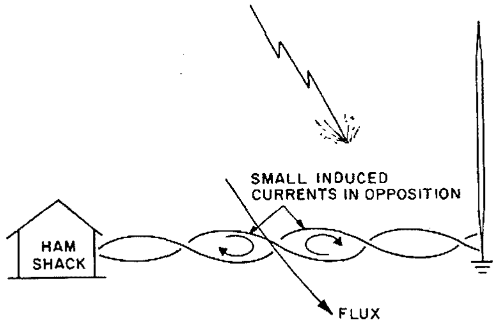


Fig. 9. Induced power is made small and averages to *near zero* if we twist the cables around each other a few times. Not recommend for twin-lead carrying rf.

A coaxial *rf* feed to the antenna is ideal for this kind of system because the *rf* is entirely inside the cable. Additional control wiring outside the coax does not upset its function. If you built a similar arrangement using twinlead, its radio performance would be completely ruined by coupling of *rf* into the control system wiring.

Relay switching

Choosing relays is much easier than finding transistors for some specific applications. Relays are uncritical, and you can parallel relays for more working contacts or series them to make up an equivalent higher-voltage winding. You can use series resistances too, if the supply voltage is high. When you are working with old or surplus relays clean the contacts carefully, and finish up with some paper to wipe out any abrasive that may remain in the assembly. Audio relays can be very small but *rf* relays will normally be large and require appreciable power. If both sides of the contact assembly are hot they must be insulated from the relay frame and from whatever metal the relay is mounted on or in. For audio applications remember the lines to the relay winding will carry noise very near the signal switching contacts and there may be enough crossover through small capacitances to high-impedance low-level signal lines to cause noise problems. It will probably be trouble with 60 Hz hum interference. This tells us low-impedance lines are preferable

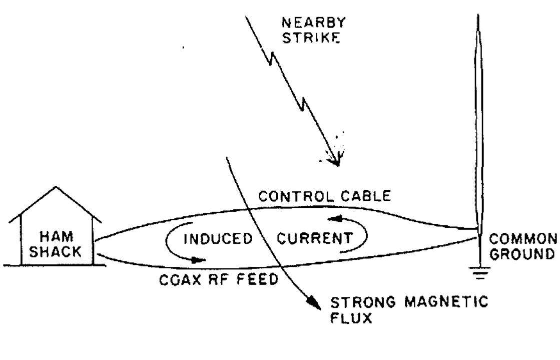


Fig. 8. Strong magnetic flux from a nearby earth strike can damage diodes by inducing large voltages if cables form a sizable open loop.

since they will usually pick up less noise in long runs.

Let's suppose we have a three-leads-and-return system to several well-separated control points. We want to complete a circuit at a particular one of them only when we have applied a one or a five control to the line. To do this we must have three relays at the control point. See **Fig. 10.**

The key is in the relay contact connections and in the general similarity between a one and a five control signal from the circuit's viewpoint. First let's suppose we have fed a one into the control circuit.

Relay 1W is closed because that line is energized. This completes this circuit . . . but wait! Why are relays 2W and 4W needed to get a No. 1 connection? Because the 1W relay is energized for 3, 5, and 7 inputs as well as a 1 input. So relays 2W and 4W must allow the 1 circuit to be completed only if the 2 W and 4W lines are not energized. This is a decoding problem.

Now let's look at the 5-circuit. This must be complete only if we feed a five to the input. At this setting the 4W and 1W lines are

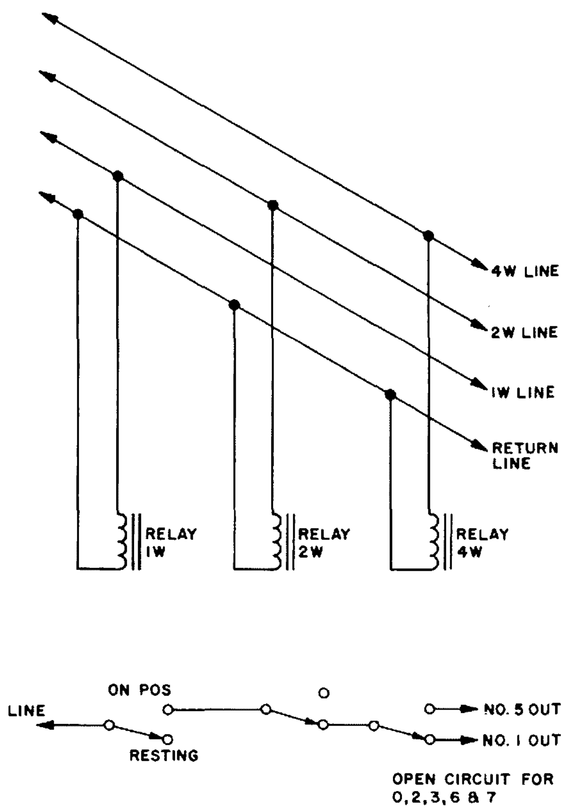


Fig. 10. Here is one station of an elaborate remote switching system. It completes a circuit when the control setting is either 1 or 5. Use this for reference in working out arrangements to function at other control settings.

energized and the 2W line is not. We wire the normally-open contacts from relays 1W and 4W together in series and add a normally-closed contact from relay 2W. In this example the two circuit conditions could share all three relays and some common contacts. You can work out other arrangements according to your individual requirements.

Since the individual relays do not interact with each other, several relays can be operated electrically in parallel but physically far apart.

A switching problem similar to this one and simpler in some ways is connecting several antennas to one transmission line or several branches to a long audio line. Here you simply arrange the 1W, 2W and 4W relay contacts to form barriers across all possible circuits except one. See **Fig. 11**, and it may seem a bit surprising to discover the least-weight 1W relay carries the most contacts.

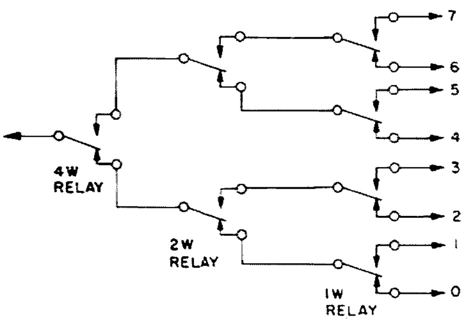


Fig. 11. Three relays can switch a line to any of eight other lines. Note the 1W relay carries the most contacts.

Finally, we have the antenna tuning problem again. There are two general ways to tune reactive antennas such as a very large loop or an off-resonance tower. These are additional inductance or additional capacitance. Let's suppose we have an antenna which needs some additional parallel capacitance. See Fig. 12.

There are four capacitors. One is always in the circuit, and it gets us into the right ballpark by tuning the antenna to the highest required frequency. Then by experiment we discover what capacitance tunes the antenna to the lowest required frequency. Let's say this works out to 410 pF max to 380 pF min. over a range of 3.5 to 4.0 MHz.

Our fixed capacitor will have to be 380 pF and we will make up the other 30 pF in seven steps, 4 plus 2 plus 1. One seventh of

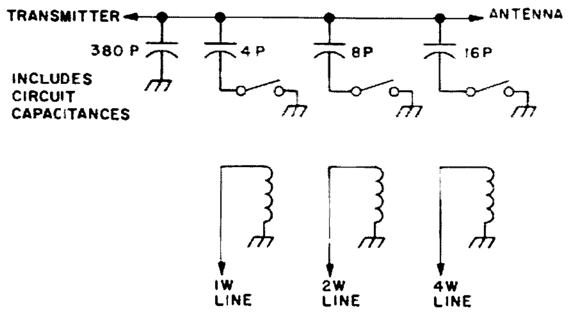


Fig. 12. Remotely located at the base of an antenna tower, this system will switch in parallel capacitances for tuning the antenna to any of eight frequencies over a narrow band.

30 pF is about 4 pF, a very small capacitance. Wiring capacitance could be important but we can absorb this in design and adjustments. It will make up part of the 380 pF.

Now, we see the three capacitors we want to switch in are 4, 8, and 16 pF, and a fudge factor we will throw in by trimming after construction. Since we can easily make up these capacitances from metal plates and surplus hardware the antenna tuning system will not be expensive.

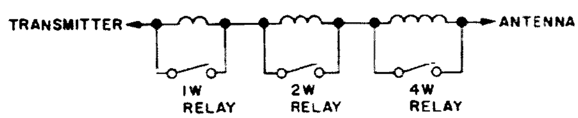


Fig. 13. Here is an arrangement, similar to that of Fig. 12, for inductive tuning. Both sides of the relay contacts carry heavy rf currents and must be well insulated;

We assemble this circuit using whatever we can find in our junkboxes or stores. After completion we make final adjustments with an SWR bridge, at the frequencies tuned by the 4, 8, and 16 pF capacitors independently. And then we go back and try the intermediate frequencies to optimize the zeroed-in points.

A similar circuit with relay contacts in series with the antenna current rather than in parallel with it, works for introducing graded inductances into the circuit. We short those we do not want operative. Toroidal inductors are good here, since if they are at least one coil thickness apart there is inappreciable interaction between them. If you use solenoidal coils they should be separated by a diameter or more. Calculation of sizes and adjustment of the system go in the same way as the parallel capacitance case.

. . . Jim Ashe

HOW TO BE AN AMATEUR

John Campbell W2ZGU

While John was never very active as an amateur (he let his call lapse now and then), he was enthusiastic and a builder of many and varied gadgets. He was best known for his remarkable editorials in *Analog*, previously known as *Astounding Science Fiction Magazine*. John had a different slant on everything and it was a rare privilege for me to get together with him now and then for a lunch. Those of you who have read his editorials know what I'm talking about – those who have missed them have missed one of the more enjoyable experiences life has offered.

In the first issue of 73 we had an interesting article by John. Perhaps it is time to reprint it.

The good amateur – that is, the amateur who is useful in causing progress in the field he's in – has certain basic characteristics that are the same, no matter what that field may be. He may be an amateur in radio, electronics, chemistry, painting, or anything else; to be useful he must have a certain basic code – the Code of the Amateur.

A Good Amateur is . . .

1. Ignorant.
2. Egocentric.
3. Impractical.
4. Disrespectful of authority.
5. Materialistic, or pragmatic – not idealistic-theoretical.
6. Inconsistent.
7. Illogical.
8. Discontented.
9. Aggressive.
10. Unfair.

Every one of those characteristics, you no doubt noticed, is generally considered antisocial; he's egocentric, and enjoys his own company, his own work, more than the best chitchat of the cocktail-party group that is, of course, the highest ideal of the extrovert-social type. The Amateur is antisocial, in that he *likes* – actually *enjoys!* – thinking! He actually prefers using his brains to flapping his jaw; he normally thinks *before* opening his mouth. This is, of course, antisocial, because it imposes the necessity of thinking on those around him – which naturally makes them very uncomfortable. They're not used to it.

The Amateur is Ignorant; this is necessary, because he wants to learn – and you can't learn something you already know. The thing that makes an amateur's ignorance so useful, however, is that you can't learn if you already *think* you know, either. The old line about "It ain't all them things you don't know that causes trouble; it's them things you do know that ain't so." The Amateur is ignorant, and escapes that trouble. Throughout history, amateurs have been lousing

things up for professionals by doing what everyone who knew anything about the business knew was impossible . . . until the amateur, who didn't know any better, did it.

Like "Mad Anthony Wayne," during the Revolution – the amateur soldier. He attacked a perfectly impregnable British position. Anyone with military knowledge knew it was impregnable, because there were sheer, 300-foot cliffs protecting it on three sides, making attack from those directions impossible. "Mad Anthony," not knowing any better, lead his men up the Palisades at night, and cleaned out the British.

The Amateur has to be Egocentric. That is, nobody's going to pay him for all the hard work he does, so he'd better enjoy what he's doing because it pleases *him*. All his work will, 99.99% of the time, yield nothing but discarded materials, and passed time. In the course of ten years, an Amateur may spend $10,000 on his hobby, wind up with $2 worth of junk, and nothing else . . . except the self-satisfying fun he had doing it.

That, by the way, is one of the ways in which the Amateur is impractical and unfair. Amateurs happily tackle a research project that has one chance in 10,000 of succeeding, spend ten years and $10,000 on it. Obviously, this is economically unsound; no professional research organization would consider so risky a venture; it would be economic suicide. For one thing, the Amateur in question may be a $100,000-a-year executive in a major corporation; he's worth that to his company, because of the extremely high level of judgment he has. That high ability to judge, to select between alternatives, is being applied in his hobby – the $10,000 worth of material he invests in his hobby is nothing compared to the $1,000,000 worth of highly trained judgment he's also investing!

But the Amateur can, of course, charge off all those expenses, all the investment of time, effort, energy and money, to "Entertainment." It's a heads-I-win-tails-you-lose setup; if his research does not yield the desired result – it still yields ten years of fine entertainment.

This is very unfair competition from the viewpoint of the professional, who has to charge all the time, effort, and money invested to "expenses" – he can't call it "entertainment." The Amateur's research project, in other words, can never wind up bankrupt – in the red – a net loss. The fun of doing it, not the result, is the main product; any workable result is, then, pure gravy – a bonus over and above the call of entertainment.

Time and time again in the history of Science, the great breakthroughs have been made by amateurs: the great breakthroughs always will, for all time to come, be made by amateurs. The reason's simple: a true Amateur can tackle a problem with no reasonable hope of success, and not suffer any loss. No professional can do so.

The essence of a breakthrough discovery, however, is that *it could not have been predicted* on the basis of previously known facts. Pasteur, a chemist, not a biologist or doctor, achieved the great breakthrough in medical-biological science – the discovery of germ disease. It could not have been predicted beforehand. No one could have, a year previously, reasoned that investigation of microscopic life-forms would be the way to solve the problem of disease.

Put it this way: Today, in the race for space, we need something a darned sight better than rockets. Rockets can never be developed to an economically practical method of commercial use of space; chemical-fueled rockets must consume tons of starting fuel for every pound of payload out into space. Nuclear, or photon rockets can never be used to take off from earth – the exhaust from such a rocket motor necessarily has an appalling energy intensity. It would slag down half a county behind it as it thrust itself up into space.

We *must* develop either an anti-gravity device, or a true space-drive – some kind of a device that can sink its claws into the structure of empty space, and climb like a squirrel going up a tree.

No professional will ever achieve such a breakthrough invention; if Dr. Quiddius Q. Quidnunk of the Research & Development division of the Brontosauric Manufacturing Company does turn up as the discoverer – you can bet he did it as a hobby-amateur project, not in his official capacity as an

R&D man for Brontosauric.

The reason's easy to see. Given: We want an anti-gravity device. It's worth $500,000,000 to the comapny that gets it. With a prize that size dangling, surely it pays to do research on it!

It would indeed . . . if someone could suggest someplace to start!

In 1935, Dr. Robert A. Millikan, one of the world's top atomic physicists, said it would be "250 years, at least" before we could release atomic energy. He was wrong by 243 years. What he meant was that as of 1925, no one had the slightest idea where to start looking for the answer! In 1940, they did know where to start; uranium-235 was the starting point. It took only two years to get an engineering device, once that was known.

The Amateur, because it's "entertainment," can start looking for thc placc-to-start; he doesn't have to wait for it to be discovered before launching his research.

The great Bell Laboratories had, of course, been looking for some way of amplifying electrical signals for years before that kid, Lee De Forest, came up with the triode vacuum tube. The transcontinental telephone line was impossible until an amplifier was invented. Bell needed one, knew they needed one, and couldn't imagine where to start looking for one, of course.

There's a lot of government-sponsored research being done today; Commissions, Authorities, Departments and Divisions of the government set up boards, committees, and agencies to assign research projects.

Let's imagine that government-sponsored research had been common throughout the history of the United States, and consider the probability that a government agency would have made the actually-correct assignment. The boards must, of course, act logically, with careful consideration of the opinions of the authorities in the field. Project assignments must be allotted fairly, logically, on the basis of the best available theoretical knowledge.

Would they, then, have assigned:

1. Development of a rapid, long-distance communication technique to a second-rank portrait painter by the name of Sam Morse?

2. Development of a technique for voice communication to an obscure teacher of the deaf in the Boston area, Alex Bell?

3. Development of a heavier-than-air flying machine to a two-man bicycle shop in Ohio?

Other projects would not have been assigned at all, by a committee which, not being amateur, was logical, had respect for authorities in the field, and acted on theoretical grounds. They would never, for instance, have assigned the project of developing an electric lighting system to anybody; it was proven mathematically by top physicists of the time, that such things could never be practical. The reason is one any radio ham can understand – it was "known" that the maximum energy-transfer in an electrical circuit was achieved when the resistance of the generator equaled the resistance of the load. Therefore, in an electric lighting system, one-half of the energy would be dissipated in the generator, and only half would be available for lighting. This made the maximum possible efficiency 50% – but worse, it meant that, for any sizable electric system, a tremendous amount of heat would be generated in the dynamo. Large machines would be impossible, because they would simply melt themselves into scrap.

It's most certainly true that if modern generators weren't 99% efficient, they would melt themselves into scrap. It's hard enough to get rid of 1% of ten megawatts, or 100 megawatts of heat; if the learned authorities had been properly respected by Edison, he'd have recognized the futility of inventing incandescent lights.

The Amateur can, of course, expect all kinds of trouble when he *does* achieve something. The Learned Authorities assure him he's a crackpot; not infrequently the said Learned Authorities have the police arrest him to protect the public from his phony racket. Alexander Graham Bell was arrested for trying to sell stock in his telephone company, I understand. Louis Pasteur threw his future into jeopardy when he first used his anti-rabies treatment on some Russians who had been bitten by rabid wolves. No M.D. would give them the treatment; Pasteur was not an M.D. and risked trial for murder if one of his patients died. (Things are different now; under modern laws, Pasteur would have been jailed for curing the dying patients. Now it's illegal to try to cur someone, successfully or not, unless you're a licensed M.D.)

It's interesting to realize that three of the most famous criminals in history were, technically, amateurs. Jesus, Galileo, and George Washington were all, technically, criminals and amateurs. (Jesus defied the theocratic laws of the Jewish government; Galileo taught, without being properly accredited by the orthodoxy of his time, and Washington was, of course, defying the British Crown, as an amateur statesman-general. Meanwhile, Ben Franklin, amateur diplomat, was doing a bang-up job in France, to England's most acute annoyance.)

A considerable amount of aggressive determination is, therefore, a *sine-qua-non* requirement for the Good Amateur. He can expect a battle when he does achieve his goal.

Obviously, he's achieved it illogically. If it could be achieved logically, from the accepted facts, professionals would have beaten him to it. The criminal-amateur must have achieved the goal by some illogical, unfair step. ("Unfair," when looked at closely, means "You did it by a method I didn't consider proper!" Obviously, if the professional had considered the method proper, and had tried it, he'd have beaten the amateur to the punch.)

Go back and check over the ten points that make for the Good Amateur, and you'll see why they are necessary. If he weren't discontented, of course, he wouldn't be trying to do something that "can't be done," or trying to do better a thing that can be done.

But the Good Amateur must be practical in one respect; he must not seek to compete with the professional on any fair, Even-Steven basis. He must always seek some underhanded, unfair trick. The amateur must not waste his time-effort-money on trying to do what the professional lab can do a thousand times better, faster, and easier. Don't build your own voltmeter . . . unless you want to learn, by actual building, what a

voltmeter really is. Then, of course, you're really building your own knowledge-understanding, not a voltmeter. You simply can't wind as perfect a moving coil, or make as precise and perfectly aligned bearings, as a huge production machine-complex can; it's inefficient to try. Don't try to make your own transistors. Don't try to solve any problem that the professional research labs are working on *in the way the pro labs are trying.*

The pro labs are now, just as an example, trying to find a better method of long-distance communication. They've sent up that Echo sateloon reflector; they've investigated troposphere scatter, they've explored single sideband, pulse code modulation, pulse time modulation, a thousand variations. Don't compete; you'd be "fighting fair," and would be sure to lose.

Be unfair; try finding out how telepathy works. Solve that one, and you'll junk all the multi-megabuck projects the pros have invested in. No pro researcher can tackle the problem, because, of course, it's one of those things that you can't tell where to start working.

Legend has it that Alexander cracked the Gordian Knot problem by slashing through the knot with his sword. Now there's an interesting thing about this; any amateur knows that it's a damn sight easier to untangle a snarl of wire that has only two ends than one that's been cut in two and has about 50 ends. The two-ended knot you can, at least, start *here*, and know that, by simply keeping at it, you'll necessarily come out *there*.

Any pro lab can beat you six ways from zero on that sort of problem; they've got electronic computers, large staffs, and megabucks to grind away at the starting end, and follow it through.

The one that stops the pros, though, is the Gordon Knot after Alexander slashed through. It's got 100 ends, none of which can lead to "the" end.

The real fundamental research scientist is a Good Amateur; that's why government research programs simply can't do a decent job of supporting true basic research. To be truly basic research, the project must *not* know where it's going to wind up, it must *not* not how it's going to get there, and must *not* be logically deductible from known factors.

The "tunnel diode" was the result of a Good Amateur type experiment; the result obtained not only could not have been predicted by previous knowledge – previous knowledge specifically predicted that it couldn't happen! Since it is theoretically impossible for electrons to travel at the speed of light, it could be shown that, theoretically, no electronic mechanism can have signal-transit times as short as light-speed would make possible.

Happily thumbing its miniscule nose at theory, the tunnel diode is an electronic device with signal-transit velocity equal to light-speed.

It also violates all proper transistor solid-state semi-conductor theoretical approaches. To be any good, a solid-state semi-conductor must have very, *very* VERY little impurity – "doping" – in it. The tunnel diode results from doping the germanium or silicon like crazy. Do the wrong thing – that's what works!

In the early days, the hams got shortwave radio going by doing wrong things like taking the carefully manufactured tubes right out of their carefully cemented-on bases, and soldering the leads directly into their circuits.

The real motto of the amateur must be, "Never give a pro an even break! Be unfair!"

To be a Good Amateur, don't compete with the pros – do what no pro would ever think of doing. And be egocentric – whatever project you pick, pick it because you like it, not because somebody says it is your duty. That way, you're playing the heads-I-win-tails-you-lose game; no matter whether your project succeeds or not, you'll have had a hell of a lot of fun! Tackle the absolutely impractical projects – the ones where you'll have no pro competition. And always disregard Authorities; of course they're sure it's impossible. If they weren't they'd have gone after it themselves. A thing can be economically impossible for professional research – and be completely practical for the happy little amateur. Lord knows climbing Mt. Everest is economically impossible in any profit-and-loss sense. What possible financial

profit can be made up there?

And the amateur doesn't have to explain *why* his gadget works; to hell with theory! Be pragmatic; simply use it. Show *that* it works, and let the red-hot theoreticians worry about *why* if they want to.

Also, be ready and willing to be completely inconsistent at any moment. If, one day, while working on a new idea for a two-meter half-kilowatt rig, that you've told everybody is going to be a two-meter transmitter, said unit should suddenly start rising off the bench and floating up toward the ceiling – be inconsistent! Say, "I'm building an anti-gravity machine," and if somebody protests that you said it was a radio transmitter – why, point out that it obviously *is* an anti-gravity machine, so, obviously, that's what you were actually building. That's common sense, isn't it? Why should you care that it consumes a full gallon, and peeps out with only 2 watts on 2? It floats, doesn't it?

Always be willing to change your project if something better slugs you along the way. Like George Baekland; he was trying to synthesize some complex organic chemical, when the chemicals in his apparatus clabbered, turned into goo, and finally set into a solid mess. Efforts to clean his apparatus of the stuff proved totally futile; he couldn't dissolve the mess in anything he could find; it just sat there sneering at all his high-power solvents.

Of course, other chemists had had similar sad accidents, and had had to throw away not only their chemicals, but their apparatus as well. Baekland was by no means the first to wind up with a mess that nothing known to chemistry would remove. "I," he decided, "am *not* synthesizing 1, 2-alpha, betaomicron after all. I'm synthesizing something as useful as the fabled Universal Solvent – the Universal Insoluble! Since I can't get rid of the damn stuff . . . there must be somebody that wants a material that stubborn, so I'll sell it." With that inconsistency of approach, things were easy. It was a snap to remove the apparatus from the mass of Bakelite – the glass would break, or dissolve in hydrofluoric acid.

Remember, too, that Bell was working to invent the "musical telegraph" – what we now know as carrier-frequency telegraphy – when he got the wrong result. He was a Good Amateur, and immediately decided he was inventing a telephone instead of a musical telegraph.

There are lots of patents to be gained by seeing how *bad* a job you can do. The body-capacitance burglar-alarm, for instance, is the worst possible approach to a stable VFO exaggerated and patented. Almost anything that is *extremely* one thing or another has some useful application. *Vide* Bakelite. Transistors tend to be very temperature-sensitive; they make wonderful high-sensitivity thermometers because of that. The R-C oscillators such as the multivibrator are horribly unstable . . . which makes them wonderfully useful as frequency multipliers and/or dividers. Being inherently unstable, they'll happily lock in with the frequency of any nearby oscillator.

Each of the characteristics I've listed as necessary to the Good Amateur is considered antisocial. Each of them is . . . in the wrong place, or wrong degree. But be inconsistent about that, too; in the right place, and right degree, each of them is tremendously useful.

I do not, for instance, recommend disrespect of Authorities when they say "The human organism does not normally operate well after being connected to a 2000 volt power supply."

It is also necessary to respect authorities in another sense; they should be respected just as you should respect rattlesnakes, mules' heels, and dynamite. They frequently have power, and should be treated accordingly.

The crackpot is the bird who not only fails to respect authority, but also fails to respect good judgment.

The Good Amateur, of course, fulfills the only usable definition of a Genius: "A Genius is a crackpot who makes money at it."

Naturally . . . because "makes money at it" is simply another way of saying "has an idea which is economically sound and workable."

Remember that almost any crackpot can *get* a patent; it takes a genius to get one *and sell it!*

. . .W2ZGU

A Simple Reverse Current Battery Charger

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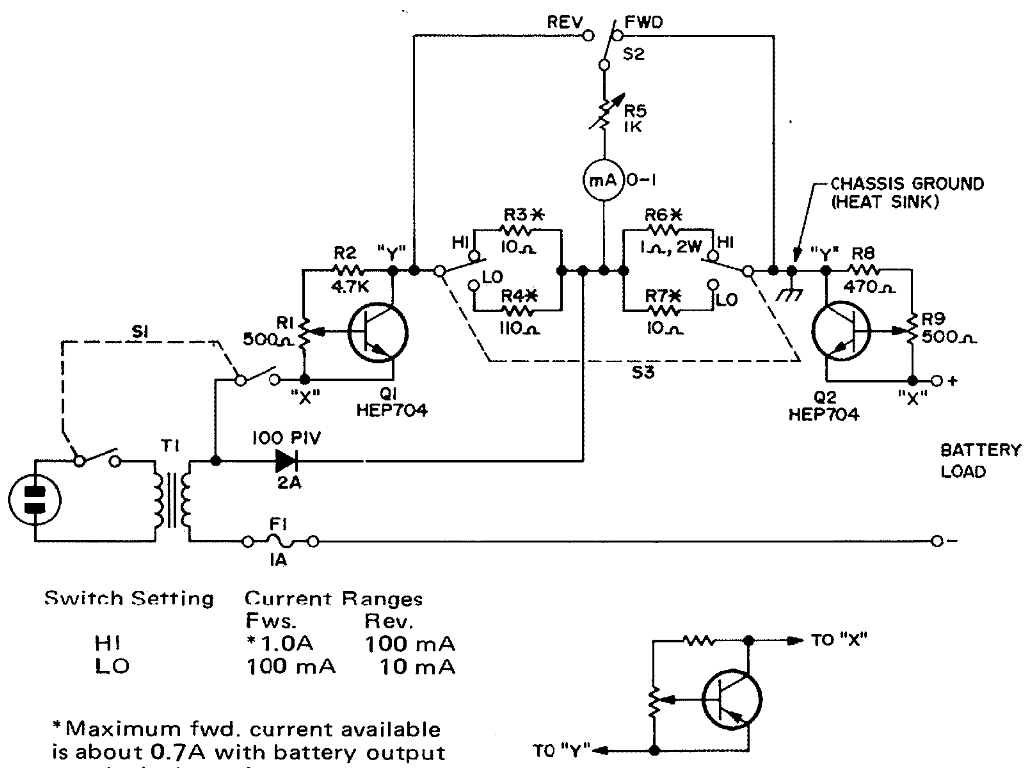
The reverse current charging technique described in an earlier issue of 73[1] is very effective but it is awkward to change the forward- and reverse-current resistor values whenever the battery type or the number of cells to be charged is changed. A resistor switching arrangement was next tried but lacked the flexibility of continuously variable controls. Also variable resistors of the required power ratings were found to be too bulky and expensive.

I next tried using manually operated current-limiting transistors for both reverse and forward current control as shown in the schematic. The control potentiometers were now low-wattage units, since they only had to handle transistor base currents. Current adjustment was also smooth and noncritical for all forward- and reverse-current values ordinarily needed to charge all types of batteries. A current metering circuit was added to permit accurate current monitoring over the range of 2–500 mA. Note that a DPST switch is used for



Switch Setting	Current Ranges Fws.	Rev.
HI	*1.0A	100 mA
LO	100 mA	10 mA

*Maximum fwd. current available is about 0.7A with battery output terminals shorted.

Fig. 1. Schematic.

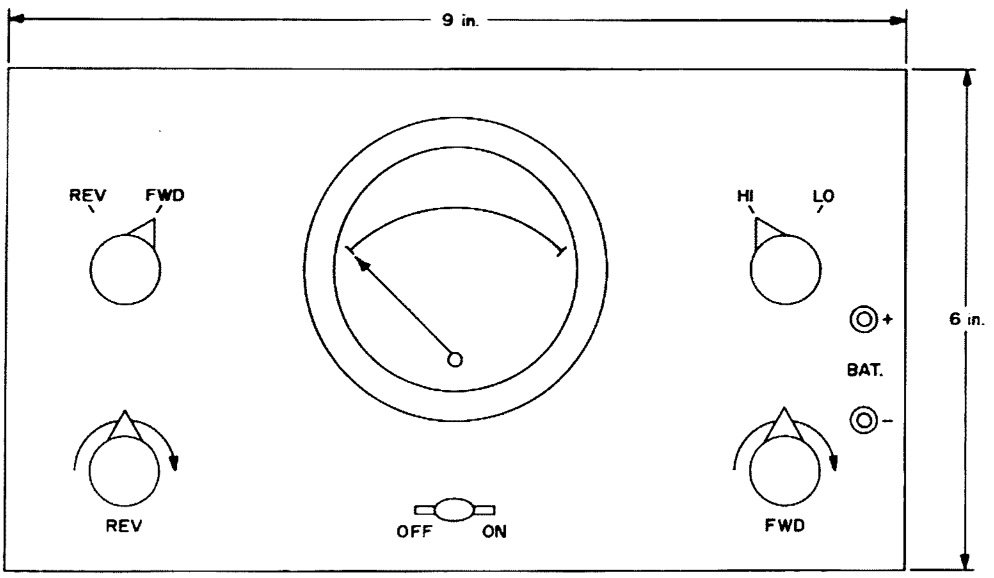


Fig. 2. Panel Layout.

on-off. This is so the batteries will not accidentally discharge through the reverse-current transistor and transformer secondary winding if the charger should be turned off without first disconnecting the batteries.

Construction of the unit presents no problem since layout and lead lengths are not critical. Panel layout of the original model is shown in Fig. 2. The forward-current transistor (Q2) is bolted directly to the chassis which acts as a heatsink. For this reason both charger output terminals are above chassis potential and must be insulated from the panel and chassis. The reverse-current transistor (Q1) is merely insulated from the chassis by insulated shoulder washers and requires no heatsink. It never has to dissipate more than 1W under any operating conditions, which is far below the dissipation ratings of the 2N3055.

If you happen to have equivalent PNP silicon transistors of the proper ratings, they may be used in place of the NPN types shown by just reversing the transistor and its voltage divider connections as shown in the insert on the schematic. Do not attempt to substitute germanium power transistors for the silicon types, however; germanium power transistors are quite temperature sensitive and will require constant readjustment with the simple circuit used in this charger.

The metering circuit uses a 1 mA meter in a simple current measuring circuit. If the recommended resistors shown are used, no calibration will be required other than adjusting the meter series resistor (R5) on the lowest current range. This is most readily accomplished by using another milliammeter in series with the 10 mA shunt and adjusting R5 for full scale with 10 mA flowing through the circuit.

In case you are wondering about the odd value of shunt resistor R4, remember that the meter circuit takes about 10% of the total current. This requires that the shunt resistor be increased in value to give a true meter reading. On the higher current ranges this compensation is unnecessary since the meter current is 1% or less of the total current in the circuit.

Other meter movements may be used instead of a 0–1 mA meter. For instance, if a 50 μA meter is used, change R5 from 1 kΩ to 20 kΩ and R4 to 100Ω since meter loading on the circuit would be negligible, even on the 10 mA range.

Operating the charger is simple enough: Select the proper current range, adjust the forward current potentiometer to the desired current value, throw the switch to the reverse-current position, and adjust the reverse-current potentiometer to 10% of the forward-current value. It is a good idea

at this point to again check the forward current and readjust as required. It will be found that the simple transistor regulators have adequate temperature stability for this application and will require little or no readjustment after warm-up.

Results have been very satisfactory when using this charger in a variety of ways including trickle charging. All battery types have responded well when recommended charging rates and duty cycles as recommended by the battery manufacturers have been adhered to. The only variable results experienced were when attempts were made to "recharge" the lowly carbon–zinc cell.[2] Apparently rejuvenation of these cells is quite dependent upon the duty cycle and age of the cell.

. . .W6FPO■

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[1] Windolph, "Reverse Current Charging," 73, March 1970

[2] Lomasney, "Charging Dry Batteries," 73, December 1967

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IT'S IN THE BAG

Heh, heh, tomorrow I will sign the contract that will put everything in the bag. There will be no *possible* chance except for me to win for . . . but wait, I must start at the beginning of my epic saga.

In the seven plus years I have been a ham, my primary interest has been the VHF bands. Early in my career, I was introduced to – and addicted by pushers of – VHF QSO contests. Throughout school, I would wait not for finals, or my visit to a distant YL, but for the fateful VHF weekend in June.

Without fail, at its close, I would mutter some indiscreet phrase, and end it with "wait until September," while I was hastily packing my bags for a DX visit with . . . er . . . she is a different story altogether.

After persecuting myself through one full year of VHF QSO contests, I decided that there must be a better way, and at that moment plans began to form for a weekend DXpedition, practicing in the art of hilltopping. During that spring, my weekends were filled with flat tires, stuck cars and fogged-in mountains. By the end of that spring season on scouting jaunts, I felt I could make my move into the bigtimer's league of hilltopping. By the end of *that* contest season, a review of the results were: three lost contests *with* higher scores, two more flat tires, and a local fame for being crazy. After acquiring this fair amount of first-hand knowledge of driving up goat trails called roads, I published a concise article on "Ye Olde Fine Art of Hilltopping."*

*Connell, Patrick O. "Observations of Note by a VHF Addict", 73, Sept. 1967.

Perseverance does pay off, sometimes. By some fantastic coincidence, during the next season's first contest, everything went bad for everyone else, and I wound up with a section winner award. Gee, if I ever have had a high point, that was it.

I proceeded through another season of mountain tops and YL-less weekends which, except for the fun of it, and the reward of a good sunburn or two, accomplished nothing.

Then came the fateful year – 1968. I was ready, willing and surprisingly enough, *still* able. I looked as though I had as large a logistics base as a small army. Two meters, 220, and my new secret weapon, 6 meter SSB. While the latter was only 20 watts PEP, I thought of it as 2000. I was ready. At the site, I wound up putting on quite a show for the lookout, while I was lugging seemingly unending tons of equipment up the last couple of hundred feet of craggy mountain. Ready, four hours to go – 2, 1, five minutes – *charge*. The bands were like 20 meters; what a pileup! Wow – I can't work anybody. Shriek. On six, I worked a local who thought I was Hot Springs, Arkansas, instead of Hot Springs Mountain, San Diego section.

Have *you* ever been situated above the inversion layer? I cried while listening to locals speculate as to the manner of my demise was it driving off the road, or suicide when I found out I didn't bring extra fuses? In such a situation, the station above the inversion layer can hear everything, but cannot break down through the layer. It is a unique experience. All I could do was to call a forlorn CQ every hour or

so. I was depressed enough to try to jump off the mountain, but thought better of it and decided instead to go up and visit the YL manning the U.S. Forest Service Lookout.

This was my big break. The fates were slowly moving in my favor. At the time I had a semester left prior to obtaining an associate's degree in electronics and I was considering various fields for possible post-grad work. Beth did it.

Within weeks I was packing my foul weather gear for a winter at the University of Montana's *School of Forestry.* During the span of a matter of weeks, I changed from a Bermuda shorts-clad-Californian to what looked and felt like a set from "Sergeant Preston and the Royal Canadian Mounted Police." Well, during that winter and the following summer, which I spent working for "Uncle Smokey" in the Coeur D'Alene National Forest, I did not get much hamming in. In fact, that summer was the first in years that I missed a VHF contest. The fates were slowly working for me, but they were so doggone slow I didn't even realize it. At times I had to deliver supplies to various lookouts in my district. Something was clicking. At first, I just stood there and said something like, "Gee, you sure have a beautiful view up here" . . . but *subconsciously* I was thinking, "Man, whatta site – no repeaters – beautiful." By the end of that summer, I was visiting other lookouts on my days off and was filling a pad with notes mentioning things like clear elevation, mileage to metropolitan areas, repeaters, and so forth. I was slowly gathering data for my supreme effort.

Once school started, the Forest Service sent student contract forms to the Forestry School to obtain us students of Walden for summer employment. Needless to say, I just happened to wind up with an excellent lookout position right on the Continental Divide for next summer.

It's in the bag. Spokane, Missoula, Helena and Butte are assured contacts. Beautiful. I know there might be some minor things go wrong, but it's fate. Murphy is sunk. It's in the bag.

. . .WB6JLC■

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PASSIVE REPEATERS

. . . for amateur UHF and microwave systems.

A previous article dealing with reflector techniques in ham microwave systems placed emphasis on the application of "periscope" antenna systems using passive reflectors. These were in near-field configurations. That is, where the reflector is within a few hundred feet of the exciter antenna and closely coupled with it.

Another technique of utilizing passive reflectors is in the "far field," where the passive reflector is used actually in lieu of an active repeater, many miles away, and thereby derived the name "passive repeater."

It will be the purpose of this article to show typical far field and near field passive repeater configurations and how to compute them. All calculations will be based on slide rule accuracy. In the course of the article we will also include some discussion concerning UHF and microwave propagation and antenna theory. We will also touch on a bit of communication system economics and engineering philosophy as they apply to commercial systems. These may then be extrapolated to amateur systems. There are a number of reasons for this, not the least of which is the fact that it is less expensive to install a passive repeater than an active repeater. Of course, amateur microwave gear doesn't cost anywhere near the price of commercial equipment for the commercial systems; but it can be much more difficult to construct or obtain from the amateur's point of view. This fact alone makes an optional repeater method (passive versus active) highly desirable.

Also, there is little if any maintenance associated with the passive repeater. With

no moving parts there is little chance for failure. Commercial passive repeaters have been in operation for over 15 years without ever needing maintenance.

By using passive repeaters on mountain tops, microwave system engineers can use the mountains as tall towers to get the necessary microwave path clearances. This means the active repeater stations can be placed down by existing roads and existing power lines for easy access during the winter.

Access roads and power lines are often the most expensive part of a microwave system. Access roads will cost from $1,000 per mile for simple graded trails across flat desert land to $40,000 per mile and more in forested mountain areas. Average cost is around $15,000 per mile. Add to this the cost of power lines starting at $15,000 per mile plus a minimum of about $30,000 for the radio gear for the active microwave repeater, and a commercial active microwave repeater can be a very expensive proposition. For the amateur it would be an impossible situation. In the cost figures above we have not included costs of towers, antennas, emergency power sources, buildings, etc., nor the costs and political problems involved in obtaining right-of-way easements for roads and power lines.

The passive repeater costs only a fraction of the price of the active repeater – plus the earlier mentioned fact that there are no operating or maintenance costs associated with the passive repeater. An *active* repeater will cost from $1,600 to $5,500 per year to operate and maintain, or more, depending on the complexity and accessibility of the repeater. Since the usual microwave system has a projected life span of a minimum of 15 years, operating and maintenance costs of a given repeater can exceed $50,000, which can pay for several good sized passive repeaters. By eliminating active equipment which is subject to failure, the microwave system becomes more reliable. The active stations that are necessary in the passive system have a low mean-time-to-repair due to their greater accessibility at the lower elevations, all made possible by the passive repeater on the mountain. The need for special purpose snow vehicles (for access to mountain-top active repeaters) is done away with; and perhaps most importantly, the maintenance man does not have to risk his life trying to get to a mountain top active repeater just to replace a blown fuse.

These are some of the reasons passive repeaters are used in commercial systems. They will have equal application in amateur systems.

Now, before learning how to engineer passive repeaters, let's discuss both what they are and some of the common misconceptions about them.

What is a passive repeater? Basically, it is a radio mirror. It can redirect a radio beam in much the same manner that sunlight or light from a flashlight can be redirected by a mirror. Where a very wide angle (in excess of about 135 degrees), is to be turned, better aperture efficiency is obtained by using two reflectors. (See Fig. 1.)

Actually, a passive repeater is nothing more than an extended antenna system. The passive repeater may be thought of as a section of a large parabola with the exciter parabola actually being the feed device for the giant reflector. While the giant reflector apparently is not curved, if one investigates a small section of a paraboloid, it will appear to be straight. It can be shown that a circle is actually a series of straight lines.

There is considerable confusion extant, even in engineering circles, concerning the operation of passive repeaters. One frequent question that occurs is "How can the passive repeater, a flat surface, have gain?" However, it is necessary to define "gain." In antenna system work gain is referenced to an isotropic point source which has 0 dB gain. Any change in aperture from other than a point source will result in energy being directed more in one direction than in another. The same amount of energy is available, but more of it is radiated or directed in one direction and less in another, so that along the axis of maximum radiation, there is said to be "gain" relative to the isotropic source. This direction of energy increases as the aperture (either

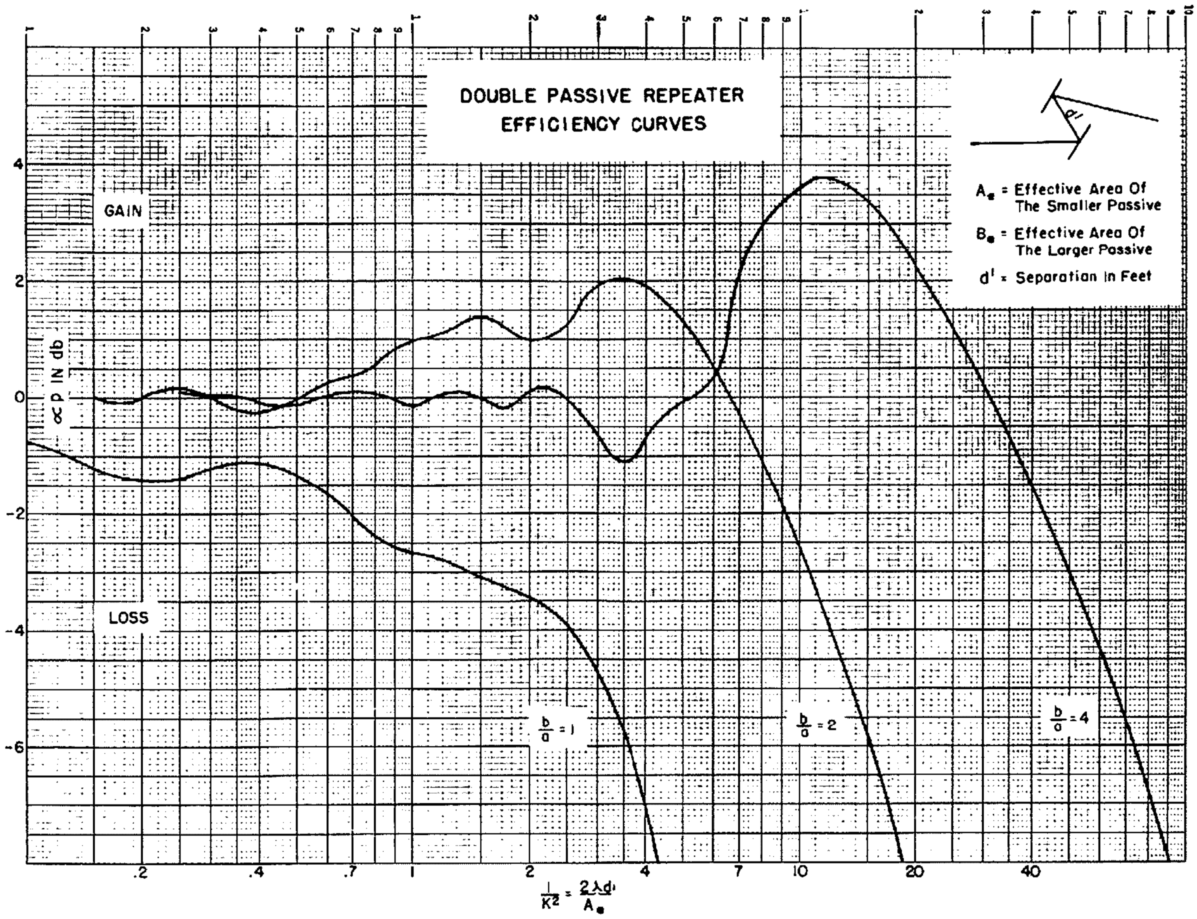


Fig. 1. Double passive efficiency.

curved or flat) increases, and therefore gain increases.

Quite probably, the difficulty most people have in understanding the aperture concept of antenna gain relates back to a common misconception about parabolic antennas. This common misconception professes that it is the focusing effect of the parabola that gives it its gain. Therefore, goes the faulty conclusion, since the passive repeater doesn't focus, how can it have gain? The truth of the matter is that it is not focusing that gives the parabola its gain. The focusing is merely a convenient means of transition from a large aperture (the dish) to a closely spaced small aperture (the feed device).

Also, if we change the position of the feed device, we simply change the amount of curvature in the reflector assembly to project the focal point at a different location. There is, then, a change in focusing, but no change in aperture gain; so gain is a function of aperture and is related to the isotropic point source – not the function of focusing. Figure 2 shows the metamorphosis of the curved, parabolic antenna, with its closely spaced feedhorn, to the plane-surfaced passive repeater. Notice that the plane-surfaced passive repeater may be thought of as a parabolic surface with an infinitely long focal length. Investigation of the method of calculating antenna gain in any antenna engineering handbook will show that only aperture and frequency are considered. Focusing does

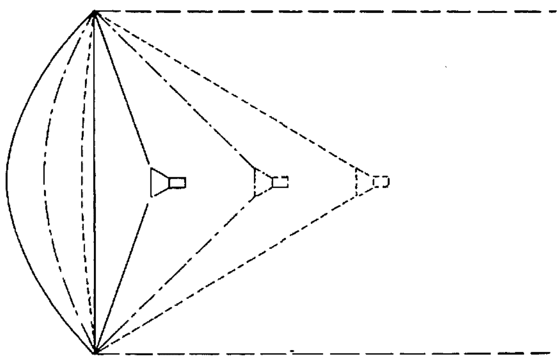


Fig. 2. Metamorphosis of parabola to plane reflector.

not enter into the method of calculating antenna gain.

Another problem that frequently arises regarding the understanding of the operation of passive repeaters has to do with beam spreading. Even many engineers often wonder how the passive repeater is able to intercept enough of the half-power energy (3 dB beamwidth energy) that may have spread over a one-mile arc after coming from some 30 or more miles away. However, it is not half-power beamwidth energy that is the consideration in passive repeater work. Rather, it is Fresnel (pronounced fruh-nel) zone energy that is to be considered. (The first Fresnel zone is that region where if a reflection occurs, the reflected wave will travel 0–0.5 wavelength further than the incident wave.) Even the parabola of an active repeater is unable to intercept all of the half-power beamwidth energy, and the electronic apparatus does not mysteriously reach out and suck it in. Fresnel zone radii is the secret. There are an infinite number of Fresnel zone radii. The first is a zone where all the energy has phase characteristics that are additive. The second is reversed in phase from the first so that if both first and second zone energy were received, cancellation would occur. This holds true throughout the infinite spectrum of Fresnel zone radii. Odd-numbered zones reinforce; even numbered zones cancel. Fortunately, most of the power is in the first dozen or so Fresnel zones. So we may limit our concern in a practical fashion to those zones.

We can calculate the radius of the first Fresnel zone and compare this with the passive repeater aperture to find some interesting comparisons. Assume two paths, path 1 being 30 miles long and path 2 being 2 miles long. In Fig. 3, it has been determined that a repeater is required at point B to connect points A and C. Assuming we plan to use a passive rather than an active repeater, we are curious to know what the full first Fresnel zone radius would be for such an arrangement so we may compare this with passive repeater

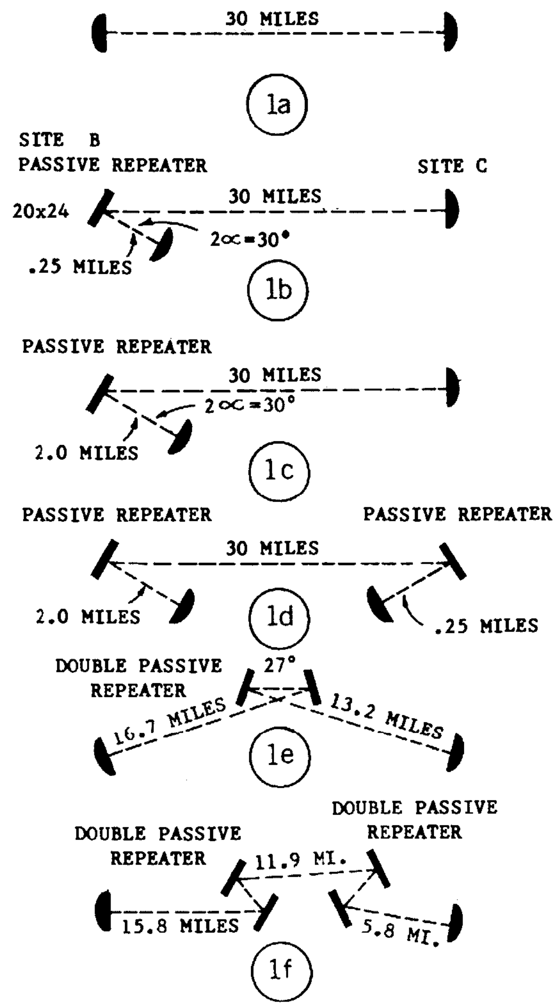


Fig. 3. Variations of mW paths.

apertures. To determine Fresnel zone radius we apply

$$R_f = 2280\sqrt{\frac{(n)\, d_1 d_2}{D\, f}}$$

where

R_f = radius of the n Fresnel zone
n = number of the Fresnel zone of interest
d_1 = length of path 1
d_2 = length of path 2
D = combined length of the two paths
f = operating frequency in megahertz

So, assume we are going to operate a microwave link on 10.125 GHz and we wish to know what the radius of the full first Fresnel zone would be for the paths above. Our calculations would look like this:

$$R_f = 2280\sqrt{\frac{(1)(30)(2)}{(34)(10{,}125)}}$$

$$= 2280\sqrt{\frac{6.0 \times 10^1}{3.442 \times 10^5}}$$

$$= 2280\sqrt{1.777 \times 10^{-4}}$$

$$= (2280)\,(.0143)$$

= 32.6 ft for the radius of the first Fresnel zone under the conditions outlined above.

Now, if we were to construct a reflector with a radius of 32.6 ft, we would find that we are intercepting all of the radiated energy that has a positive phase relationship and redirecting it in similar phase. Therefore, we are effectively increasing our power gain by a theoretical 6 dB. (See Fig. 4.) In practice it will be more like 5 dB or so, depending on the aperture coupling ratio of the passive repeater to the parabolic antenna that excites it. This gain is antenna system gain in a near field condition, and is added to the gain of the exciter parabola. To prove this mathematically, refer to the universal gain curve in Fig. 4 and compute for 1/K.

$$1/K = \frac{\pi \lambda d}{4 A_e}$$

where,

$\pi = 3.14$

$$\lambda = \frac{985}{f(\text{MHz})}$$

d = distance, in feet, between antenna and reflector

and where

A_e = effective area of reflector, (height x width x cosine of half the horizontal included angle).

A = (a) (b) for rectangle,

$$A = \frac{(a)\,(b)\,(\pi)}{4} \text{ for ellipse,}$$

$A = \pi r^2$ for circle.

So, for the link we're working with, let's check the 4-mile path first to see if we're

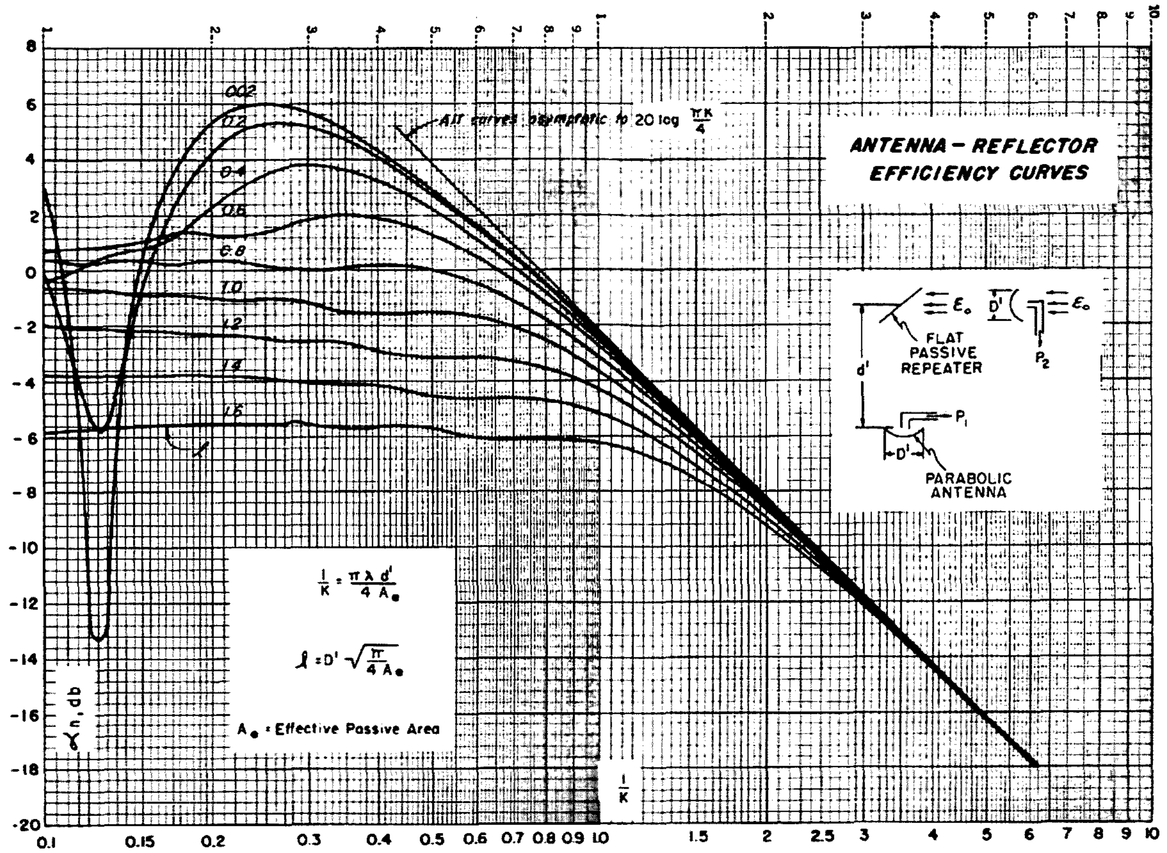


Fig. 4. Universal gain curve.

"near field." We determined earlier that for 10.125 GHz the radius of the first Fresnel zone would be 32.6 ft. Let's assume the reflector is an ellipse whose effective radius at the specific horizontal included angle, is 32.6 ft.

$$1/K = \frac{\pi \lambda d}{(4)(A_e)}$$

$$= \frac{(3.14)(985/10{,}125)(2)(5{,}280)}{(4)(32.6)(32.6)(3.14)}$$

$$= \frac{(3.14)(.0972)(2)(5{,}280)}{(13{,}300)}$$

$$= \frac{3210}{13{,}300} = .24$$

A word of caution here: Don't take mathematical shortcuts such as dropping out π in the numerator and denominator. The total value of (4) (Ae) will be required for later calculations. Shortcut math, if used with caution, is okay, but watch it if values are to be used later; otherwise, erroneous results will be obtained. Having determined 1/K to be 0.24 we have one more step to perform before going to the universal gain curve of Fig. 4. Before that, though, if should be noted that if 1/K computes to be 2.5 or less if a near field condition does exist. If 1/K is 2.5 or greater, a far field condition exists. If 1/K is exactly 2.5, either near or far field methods may be used to determine system gains. Refer to Fig. 5 for further discussion of near field and far field.

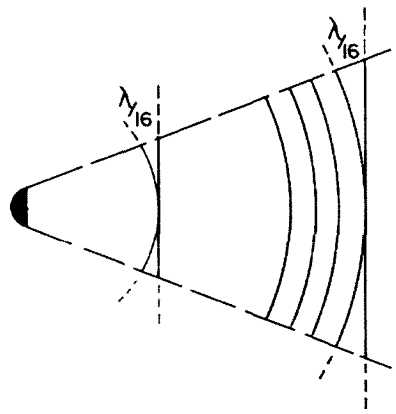
Now, the next step we have to determine is the aperture coupling ratio – that is, the ratio of the passive repeater aperture to the exciter parabola aperture. To do this we manipulate the following:

$$l = D\sqrt{\frac{\pi}{4 A_e}}$$

where D = diameter of exciter parabola,
π = 3.14
A_e = effective area

So, for this situation, let's assume a 10 ft parabola. Then,

$$l = 10\sqrt{\frac{3.14}{(4)(32.6)(32.6)(3.14)}}$$
$$= 0.235$$



WHAT ARE NEAR FIELD AND FAR FIELD? THE CLASSICAL DEFINITION OF THE OCCURRENCE OF NEAR FIELD IS THE POINT WHEN A RADIATED WAVE (THE MICROWAVE BEAM) INTERCEPTS A PLANE SURFACE (THE PASSIVE REPEATER) AND THE DIFFERENCE BETWEEN ANY POINT ALONG THE RADIATED WAVE AND THE PLANE SURFACE IS $\lambda/16$ OR GREATER. NOTE THAT EITHER MOVING THE PASSIVE REPEATER CLOSER TO THE SOURCE OR MAKING THE PASSIVE REPEATER LARGER CAN RESULT IN CREATING A NEAR-FIELD SITUATION. THIS CAN BE USED TO GOOD ADVANTAGE WHEN ENGINEERING A PASSIVE REPEATER PATH.

Fig. 5. Near Field/Far Field discussions

Having $1/K = 0.24$ and $l = 0.235$ we now go to the universal gain curve of Fig. 4. Enter the graph at the bottom where $1/K = 0.24$. Read vertically to where $l = 0.235$. (You'll have to visually interpolate here a bit.) Then read horizontally to the left where you'll find the gain to be added to the antenna system gain. This will be an additional 5.0 dB. A 10 ft parabola at 10.125 GHz has a gain of about 47.5 dB. Add to this the 5.0 dB derived above, and we have a total antenna system gain of 52.5 dB above an isotropic point source. The purpose of showing this near field application, with its 32.6 ft reflector radius, is to illustrate the interrelationship of operating frequency, size of the reflector, and spacing as they affect near field. Few hams are going to construct a reflector with a 32.6 ft radius. Indeed, ham applications will seldom call for anything on this order of magnitude. But for commercial systems, it is a very practical application, and in fact has been done.

Ham Passive Applications

Engineering a microwave path with a passive repeater is actually no more difficult than engineering a direct microwave path. Contrary to popular opinion, there are absolutely no rules of thumb involved in engineering a radio path using a passive repeater. Let's face it: if rules of thumb worked, there would be no need for engineers! The only things used are proved engineering techniques that make the selection of the proper passive repeater a task of less than a few minutes.

Basic Microwave Path

Probably the best way to learn about passive repeater engineering is to perform some sample calculations. It will be assumed that the reader has a basic knowledge of logarithms and trigonometry and can perform the necessary logarithmic conversions. The basic microwave point-to-point system of Fig. 3A would be calculated as follows:

First, in all cases, λ, in feet, will be

$$\frac{985}{f(\text{MHz})}$$

Then, we need to assign system values. Let's have the transmitter operating at a frequency of 1250 MHz, with a power output of 1W, 20 ft of 7/8 in. foam-filled transmission line, with 6 ft parabolas at each end. The path, as shown in Fig. 3A, is 30 miles long. Now, we convert all our parameters to decibels. It is convenient to tabulate them as gains and losses.

Gains:

+30 dBm transmitter output (Fig. 6)
24.5 dB 6 ft parabola (Fig. 7)
24.5 dB 6 ft parabola
+79.0 dB

Losses:

128.0 dB 30 miles at 1.25 GHz (Fig. 8)
0.42 dB 20 ft 7/8 in. coax (Fig. 9)
0.42 dB 20 ft 7/8 in. coax
1.0 dB connectors
129.84 dB

-129.8
+ 79.0
50.8 dBm received signal level (input to receiver).

With an FM improvement threshold level of -81 dBm this will give us a 30.2 dB fade margin.

Basic Passive Microwave Path (Near Field)

The first step in calculating the gains and losses of the path shown in Fig. 3B is

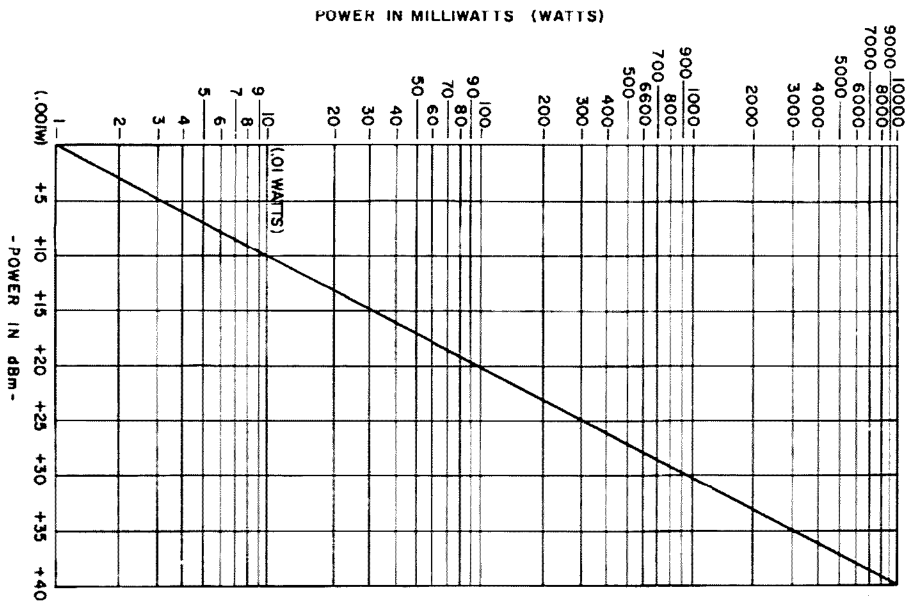


Fig. 6. Transmitter output/dB conversion chart.

to calculate the path loss of the long path as already performed above. Then with loss of the long path established, it is necessary to determine whether the short path, from site A to site B, is a near-field or far-field condition, by using the following formula:

$$1/K = \frac{\pi \lambda d_1}{4 A_e}$$

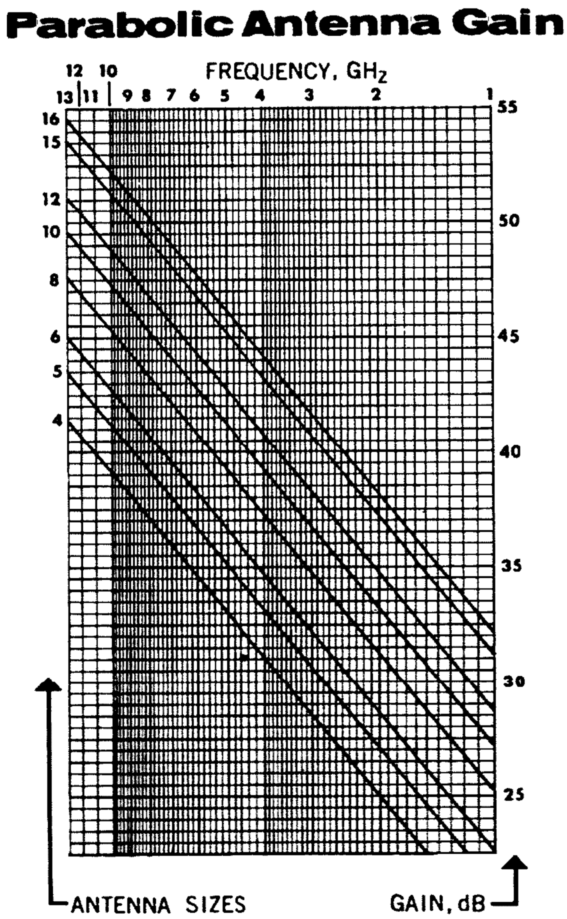
where λ is wavelength in feet, d_1 is length of path in feet, and Ae is the effective area (actual area times cosine of half the horizontal angle) in square feet, of the passive repeater.

Let's change transmitter frequency now, going to 5.787 GHz, but keep all other equipment parameters the same, except we'll change to a good-grade waveguide, since we're to be in the higher frequency. A waveguide similar to EW-59 shown in Fig. 10 will suit our purposes.

$$1/K = \frac{(3.14)(0.17)(5280)(0.25)}{(4)(20)(24)(\cos 15^\circ)}$$

$$= \frac{706}{1875} = 0.387$$

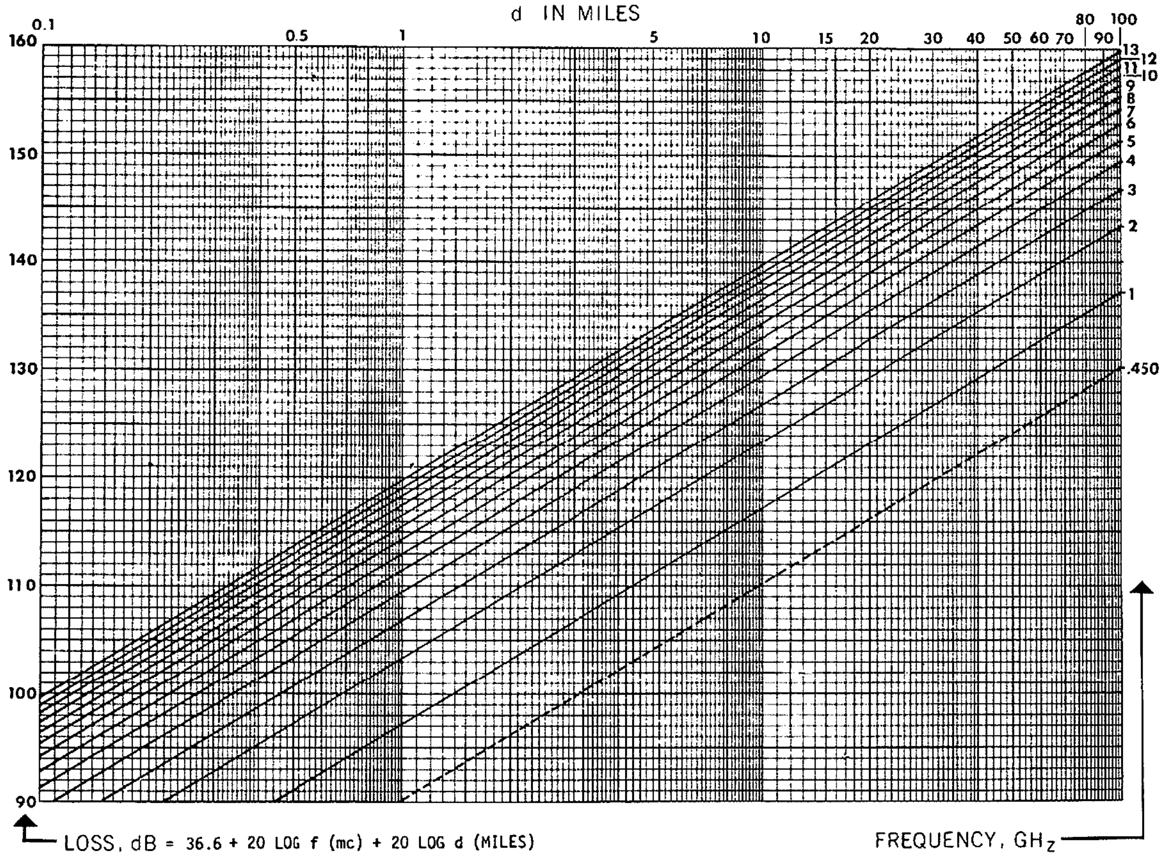
If 1/K calculates to be 2.5 or less, the path from terminal to passive repeater is considered near field. Thus, 0.387 is a near-field situation. The 2.5 just mentioned is not a rule of thumb. This is the crossover



GAIN "G" IN dB = $10 \log \frac{5 D^2}{\lambda^2}$

Fig. 7. Antenna gain.

Free Space Loss Between Isotropic Radiators



Reference: Microflect Passive Repeater Engineering Manual.

Fig. 8. Free space path loss.

point where there is $\lambda/16$ difference between the curved wavefront and the edge of the passive (See Fig. 5) and where the computations may be based on either the near field or far field method.

Next, since we are in a near field condition, the function l (the parabola/reflector coupling factor), must be determined:

$$l = D'\sqrt{\frac{\pi}{4\,A_e}}$$

where D' is the parabola diameter in feet, and Ae is the effective area of the passive repeater.

Then, for the situation in Fig. 3B:

$$l = 6\sqrt{\frac{3.14}{(4)\,(20)\,(24)\,(0.9659)}}$$

$$= 6\ \sqrt{0.00169}$$

$$= (6)\,(0.041)\ = 0.246$$

Now, referring to the curves in Fig. 4, the value of 1/K (0.387) is located on the 1/K scale. A vertical line is run to the curve corresponding to the 0.246 figure obtained for l. (Interpolation is necessary, here.) At this point, a horizontal line is run to the a, dB scale and the near field gain (or loss, as the case may be) is read directly in dB. For this situation, we have 4.3 dB gain.

Adding all the gains and losses, we get:

Gains:

+ 30 dBm transmitter output
38 dB 6 ft parabola at 5.787 GHz
38 dB 6 ft parabola at 5.787 GHZ
4.3 dB near field gain

+110.3 dB

Losses:

141.3 dB 30 miles at 5.787 GHz
0.7 40 ft waveguide
1.0 connectors, etc.

-143.0 dB

-143.0
+110.3

- 32.7 dBm rf input to receiver

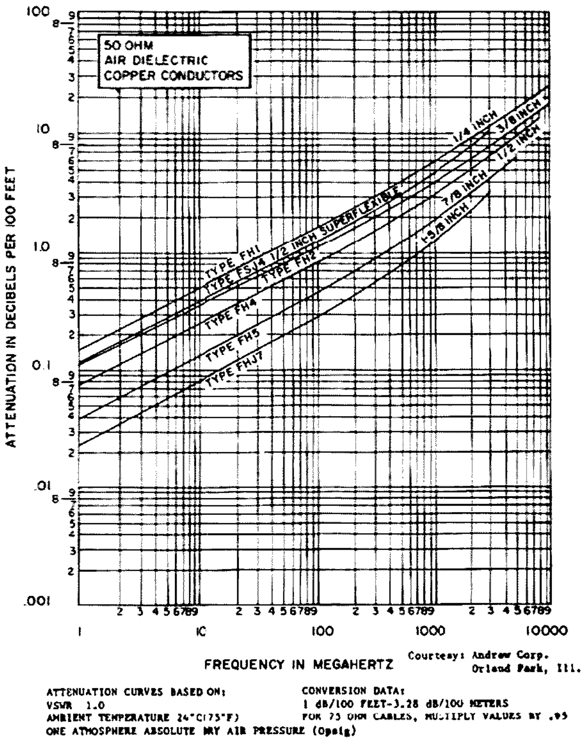


Fig. 9. Foam filled loss chart.

So, if our receiver still has a -81 dBm FM improvement threshold, we will have a fade margin of 48.3 dB. Now, if we feel we need a smaller fade margin, we can reduce the size of our passive repeater, as necessary, to give us the specific fade margin or receiver signal level we want.

Basic Passive Microwave Path (Far Field)

If 1/K should calculate to be 2.5 or greater, we have a far-field condition. Figure 3C is a far-field path at 5.787 GHz, with

$$1/K = \frac{(3.14)(0.17)(5280)(2.0)}{(4)(20)(24)(\cos 15^\circ)}$$

$$= \frac{5640}{1875}$$

$$= 3.0$$

Since it is a far-field situation, we treat the 2-mile path just like the 30-mile path, with a specific path loss shown in the calculations.

Also, with a far-field situation, it is necessary to consider the gain of the passive repeater directly in the calculations.

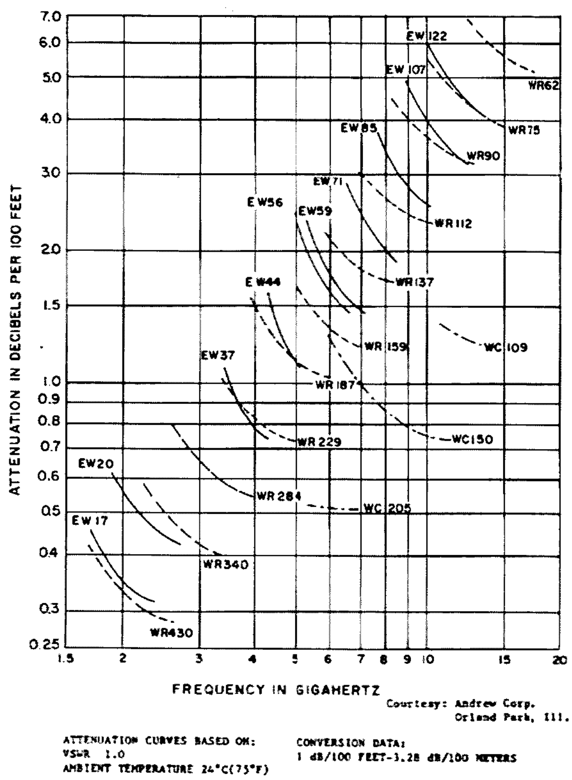


Fig. 10. Waveguide loss chart.

Referring to Fig. 11, we find the gain of the 20 x 24 passive repeater. The graph is entered at the top left at the horizontal included angle. The horizontal included angle of Fig. 3C is 30°. The graph is then read down to the curve corresponding to 20 x 24, then horizontally across to the frequency of operation (5.787 GHz), then down to the gain figure for the passive repeater (106.4 dB). Again, the gains and losses are totaled:

Gains:

+30 dBm transmitter output
38 dB 6 ft parabola at 5.787 GHz
38 dB 6 ft parabola at 5.787 GHz
106.4 dB 20 x 24 passive repeater with $2a = 30°$ at 5.787 GHz

+212.4 dB

Losses:

141.3 dB 30 mile path at 5.787 GHz
117.8 dB 2 mile path at 5.787 GHz
1.7 dB 40 ft waveguide, connectors, etc.

-260.8 dB

-260.8 dB
+212.4

-48.4 dBm Re input level to receiver.

Using the same -81 dBm threshold level, this -48.4 dBm received signal level would give us a fade margin of 32.6 dB.

One Path — Two Passive Reflectors

Figure 3D shows a common passive-repeater application where there are two passive reflectors in one path. The two passive reflectors are treated individually, as above, determining whether each is near field or far field, and the loss of the 30-mile path is calculated as usual. In practical application there are a number of variables to control the system component sizes to achieve the proper fade margin or minimum median received signal level (such as parabola size, passive repeater size, distance between passive repeater and parabola of given size, horizontal included angle, frequency and transmitter power). Economics and system noise requirements will dictate which component to vary in a

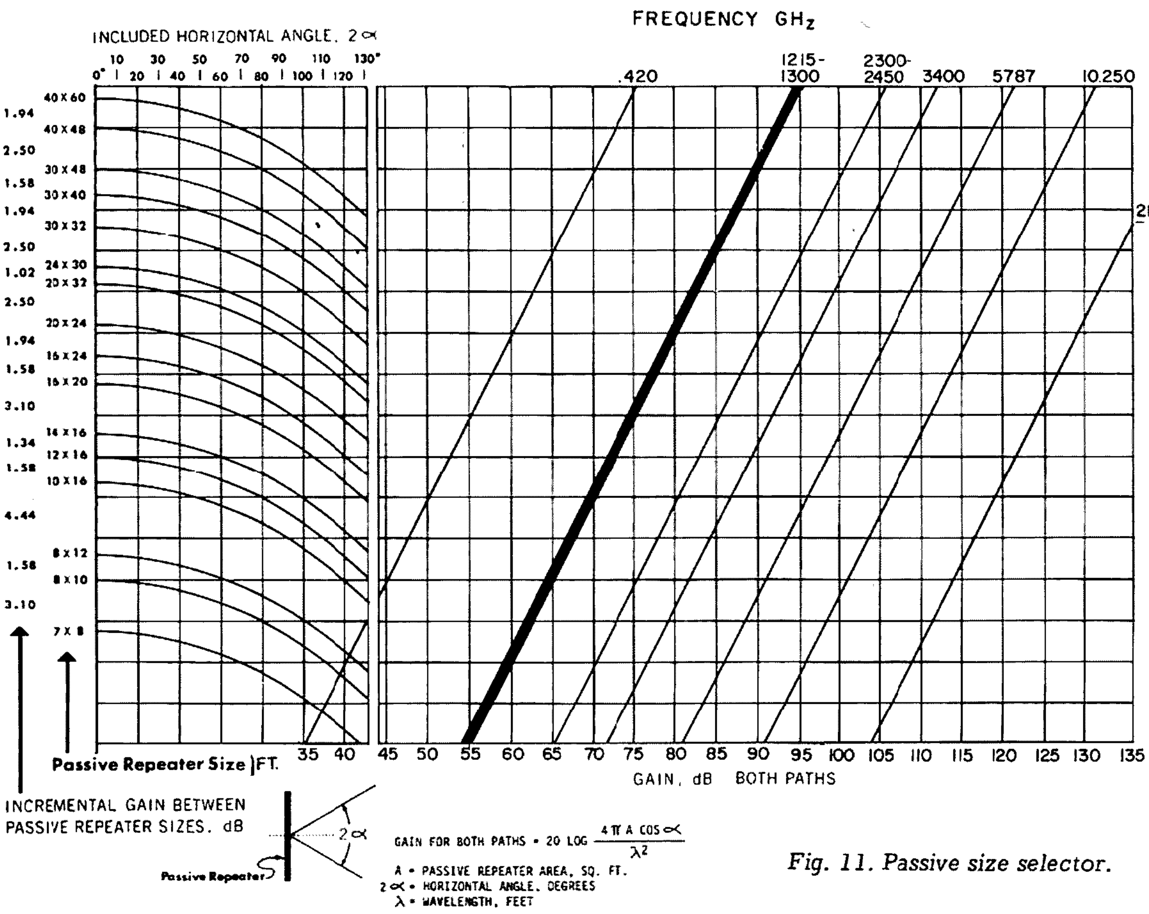


Fig. 11. Passive size selector.

given situation. In the examples shown, we have varied the parabola sizes, using practical commercially available sizes. In the arrangement for Fig. 3D, it will be necessary to substitute a 10 ft parabola for the 6 ft parabola used in the calculations associated with Fig. 3B, keeping the passive repeater size the same. This means it will also be necessary to recalculate the value of l if the 10 ft parabola is placed at the terminal with the near field path. If it is placed at the terminal with the far field path, there will be no requirement to recalculate this value. For convenience and aperture coupling efficiency, we will place the 6 ft dish at the near field terminal and the 10 ft dish at the far field terminal.

So, for path arrangement of Fig. 3D we have gains and losses totaling:

Gains:

+ 30 dBm transmitter output
38 dB 6 ft parabola
42.5 dB 10 ft parabola
4.3 dB near field gain
106.4 dB 20 x 24 ft passive with $2a$ - 30° at 5.787 GHz

221.1 dB

Losses:

141.3 dB 30 mile path at 5.787 GHz
117.8 dB 2 mile path at 5.787 GHz
1.7 dB 40 ft waveguide, connectors, etc.

-260.8 dB

-260.8 dB
+221.2 dB

-39.6 dBm rf input to receiver, for a fade margin of 41.4 dB

Double Passive Repeaters

Perhaps one of the more frightening arrangements of passive repeaters, to the uninitiated, is the double passive repeater. Actually, double passive repeaters are no more difficult to engineer than any other passive repeater arrangement. There are a couple of additional manipulations required, but with the availibility of curves and graphs, most of the work is eliminated.

Double passive repeaters can be used to overcome on-path obstructions and eliminate the need for active repeater facilities.

Double-passive repeater engineering is performed just as single-passive-repeater engineering, with one additional step. First, as with the single passive repeaters, it is necessary to determine if the passive repeater is in the near field with respect to the close parabola. Seclecting the configuration in Fig. 3E, it is almost obvious that the 13.2 mile separation on the short path will result in a far-field situation. Because of distance, 30 x 40 ft reflectors will be used. Figure 12 details the layout of this double-passive-repeater shot, which is known as an "X" configuration. First, the near-field check is made:

$$1/K = \frac{(3.14)(0.17)(5280)(13.2)}{(4)(30)(40)(\cos 13^\circ 30')}$$

$$= \frac{37200}{4700}$$

$$= 7.91$$

which is definitely far field. And, since the other path is even longer, it may also be assumed to be far field.

At this point, it is necessary to determine the gain of the passive repeater. This may be done either by referring to the curves in Fig. 11, or in the case where curves are not available, the gain of the passive reflector may be calculated. To calculate passive repeater gain, the passive repeater which has the smaller effective area (actual area times the cosine of half the larger horizontal included angle) must first be determined. In the case of Fig. 12, both horizontal angles are the same (27 degrees) and both passive repeaters are the same size, so it will make no difference which we select for calculation purposes.

The gain of a 30 x 40 ft passive repeater at 5.787 GHz, with a horizontal included angle of 27 degrees is:

$$20 \log_{10} \frac{4 \pi A \cos a}{\lambda^2}$$

$$20 \log_{10} \frac{(4)(3.14)(30)(40)(0.9724)}{(0.17)(0.17)}$$

$$= 20 \log_{10} \frac{14{,}650}{0.0289}$$

$$= 20 \log_{10} \frac{1.465 \times 10^4}{2.89 \times 10^{-2}}$$

$$= 20 \log_{10} 5.06 \times 10^5$$

$$= (20)(5.704) = 114.08 \text{ dB}$$

where A = actual passive area in square feet, cos a = cosine of half the horizontal included angle, and λ^2 = wavelength in feet, squared.

There will be a slight amount of coupling loss between the two passive repeaters. The coupling loss for various spacings and passive orientations may be determined by use of the curves in Fig. 1 and the associated calculations. For example, for the conditions in Fig. 3E and Fig. 12, it would be necessary to check the b/a ratio of the two passive repeaters. This is done by determining the effective area of each of the two passive repeaters:

$$A_e = (30)(40)(0.9724) = 1168$$

$$a = 34.19$$

$$B_e = (30)(40)(0.9724) = 1168$$

$$b = 34.19$$

$$b/a = \frac{34.19}{34.19} = 1$$

If there should be a difference in the size of the effective areas, the larger effective area is considered to be b.

Determining the value of $1/K^2$ to complete the double passive repeater efficiency calculation, we find that:

$$1/K^2 = \frac{2\lambda d_1}{A_e}$$

where λ = wavelength in feet, d_1 = the separation between the two passive repeaters, and Ae = the effective area of the smaller of the two passive repeaters. The separation between the two reflectors is not critical. At frequencies above about 2 GHz and with passive repeater sizes larger than about 16 x 20 ft, the spacing may extend to as much as 1000 ft without degrading the gain of the double passive more than 2 dB. Let's assume 500 ft for the example in Fig. 12.

$$1/K^2 = \frac{(2)(0.17)(500)}{(30)(40)(0.9724)}$$

$$= \frac{170}{1168} = 0.1455$$

This places the $1/K^2$ point of Fig. 1 along the left margin of the graph. Following the $\frac{b}{a} = 1$ curve, we find a coupling loss of about 0.9 dB.

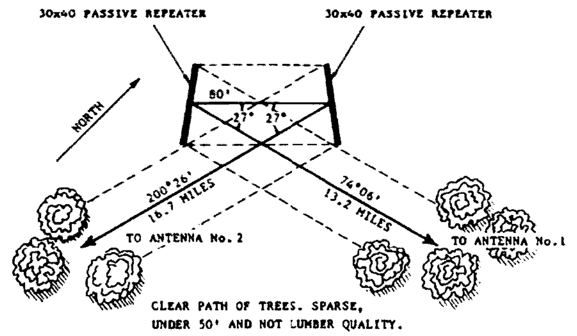


Fig. 12. Double passive repeater with horizontal included angle of 27°. Typical layout.

Losses:

134.2 13.2 miles at 5.787 GHz
136.2 16.7 miles at 5.787 GHz
1.7 dB 40 ft waveguide and connectors
0.9 dB double passive coupling efficiency
273.0 dB

273.0 dB
+229.1
43.9 dBm rf input to receiver; fade margin of 37.1 dB

Totaling system gains and losses:

Gains:

+30 dBm transmitter power output
42.5 dB 10 ft parabola at 5.787 GHz
42.5 dB 10 ft parabola at 5.787 GHz
114.1 Passive gain 30 x 40 ft at 5.787 GHz
+2291.1 dB

Thc calculations and path sketches shown on the preceding pages are not just theoretical. Similar configurations have been installed using passive repeaters hundreds of times during the 20 years or so that microwave has been a communications tool and not an experimental toy. A high percentage of the passive repeaters installed, though, have been installed only in the last 5 years or so. This is because of the spread through the communication industry of the knowledge of the techniques of passive repeaters. It is also due in great part to the demise of "rules of thumb" which formerly played a great part in the "engineering" of early-day microwave systems. One favorite rule of thumb that used to be touted and that really has no basis in fact, is the one that said, "If the product of the path lengths exceeds 30, then a passive

This 30 x 48 passive repeater operates in the 6.7 GHz industrial band, providing service for a commercial microwave system. Installed in Alaska, the passive repeater, with 118.0 dB gain, receives the signal from a station 7 miles away and redirects it to the far station more than 48 miles further on. The system carries 300 voice channels with a measured fade margin of 40 dB.

repeater cannot be used." This meant that the configuration of Fig. 3E, with a product of $(13.2)(16.7) = 220.4$, wouldn't work. Not only will it work, but there are passive repeater systems just like it all over the world that do work and are in operation today, yet the product of their path lengths exceeds 30, even 130 and even 430.

The moment the serious microwave ham recognizes that fact, he will be ahead of many professional engineers and on his way to becoming a specialist in a specialized field.

. . . W7EEX ■

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Converting the AC/DC for WWV

Perhaps the single most complete piece of gear to invade the junkbox is the standard ac/dc five-tube table radio. Millions of these radios have been produced over the years, and they inevitably end up in the junk heap or are presented to the "ham" by good intentioned friends because they know "you like radios."

They go bad for any number of reasons, but mainly the problem is failure of tubes, electrolytic capacitors, or the output transformer. Other simple problems such as cabinet breakage or dial cord problems also tend to render the ac/dc useless to the owner.

Having an unusually large supply of these on hand, the thought occurred to me that the circuits are most always the same. An antenna loopstick or ferrite rod and coil forms the basis of the rf input circuit which is fed directly into a "converter." The antenna coil is tuned across the BC band by one section of the control grid and cathode of the converter and is tuned by the other section of the variable capacitor. When the two signals are mixed the resulting output of 455 kHz is produced, detected, and amplified. In most cases this converter tube is a 12BE6 and operates in conjunction with a 12BA6, 12AV6, 5OC5, 35W4. Not coincidentally, the total filament voltage in series is 115V (see Fig. 1).

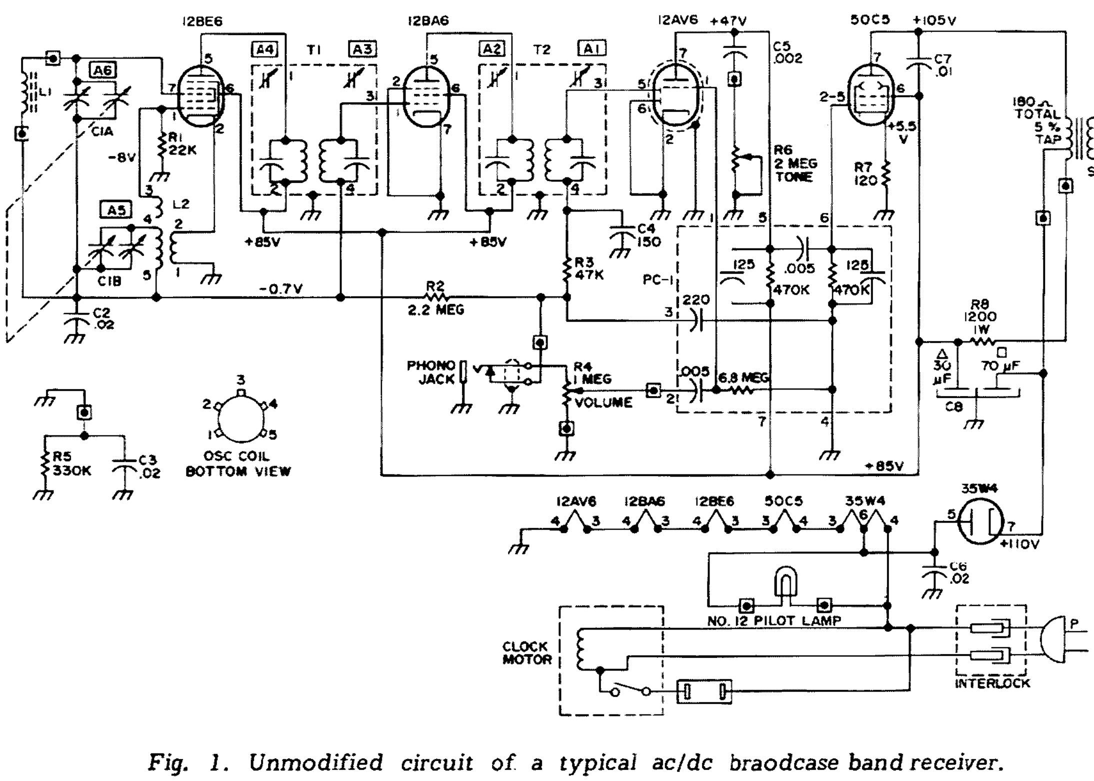

Fig. 1. Unmodified circuit of a typical ac/dc braodcase band receiver.

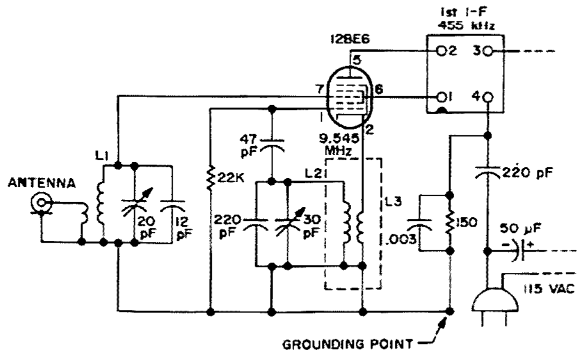

Fig. 2. Modified circuit of 12BE6 converter for WWV.

Converting the ac/dc to any fixed frequency between 1 and 30 MHz couldn't be simpler.

Remove the 365 pF variable, the ferrite coil, the oscillator coil, and all wires connecting to pin 7, 1, and 2 of the 12BE6. (Of course, you should make sure the ac/dc is operating before assembling to save some problems later on.) Next, remove all the coil windings from the oscillator coil form. This coil form is handy for the new oscillator coil and usually has mounting lugs and brackets already provided. When removing components, carefully trace all the ground wires to a single point. This is the grounding point that should be used, as it is usually isolated from the 115V ac line.

Using 26 AWG copper enamel wire, first wind a 5-turn link on the oscillator coil form connecting it to two unused lugs. Then scramble-wind the oscillator coil over the link and connect one lead to the ground lug of the link and the other to a third unused lug. Parallel a mica capacitor of between 50 and 200 pF and a 0–30 pF ceramic trimmer across the oscillator coil. Remount the coil and connect the link to the cathode (pin 2), and tie the oscillator coil to the control grid (pin 1) through a 47 pF capacitor. Insert a 22Ω, ½W resistor from pin 1 to the grounding point. Check the coil for resonance with a grid dip meter and then add 455 kHz for the indicating frequency.

In my case I desired a reception frequency of 10 MHz for WWV and found that my oscillator coil tuned from 6.5 to 10.5 MHz with the trimmer specified.

The rf section was all that remained; it consisted of 30 turns on a 3/8 in. coil form paralleled by an APC 20 pF variable and a 12 pF mica capacitor, making the coil resonate between 11 and 9 MHz. This assembly can be mounted on the bracket used to support the old 365 pF variable capacitor. Figure 2 shows the revised circuit for the 10 MHz WWV receiver. Wiring is by no means critical and mounting of an assortment of parts can be left to the constructor's imagination. Care must be taken, however, to isolate the chassis ground from all components. If an external antenna is used do not ground either lead and make sure the "safe polarity" is established when plugging in the set.

Operation

Rough adjustment can be made with the grid dipper when putting on frequency. The antenna trimmer is used to peak the signal and the oscillator trimmer adjusts frequency.

The i-f coils need not be touched as they still operate at 455 kHz. I found my new WWV monitor to be quite stable and to produce excellent quality in Pennsylvania, even during the daylight hours. In tuning the oscillator trimmer slightly up and down the band, I got equally pleasing results. No difficulty in producing a fixed receiver for any desired frequency should result, as long as the oscillator coil and antenna coil are properly adjusted.

Some future modifications might involve replacing the 12AV6 detector tube with diodes and inserting a tube with equivalent filament current and voltage for a 455 kHz bfo. Also, the detector stage could be disconnected from the audio circuit and capacitively coupled to the speaker for a code practice oscillator. In all there are, and will continue to be, many uses for this common receiver, so when somebody gives 'em away . . . take 'em

. . .W3JJU■

Fail Safe Switching

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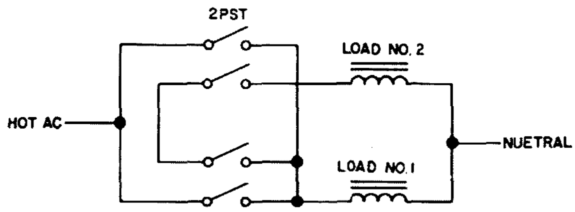

Fig. 1. Schematic for a two load fail safe arrangement.

Have you ever had a desire for a fail safe method of turning on the filaments prior to turning on the transmitter high voltage supply? Or how about a guarantee that the bias power supply will always be turned on first, so that bias voltage would be present on the transmitting tubes prior to the time that the plate supply was turned on? Perhaps you need to turn on the final plate supply prior to turning on the modulator plate supply, in order to protect the modulation transformer. Operating the modulator without a load can cause excessively high voltages to appear across the modulation transformer windings. Result–shorted transformer.

At this point someone is bound to say "Who uses a modulator in this day and age of Sideband". Well for the SSB boys; you may want to work up a fail safe arrangement to turn on the final plate supply to that 4-1000 prior to turning on the screen supply. If you aren't careful––BLOO–Y––the screen current will rise to excessive values and there goes another expensive final.

For most home constructed equipment, the only parts required are two DPST toggle switches. The schematic for a two load fail safe arrangement is shown in **Fig. 1**.

This system can be carried a bit further and by using three each 4 pole switches any three load circuits can be turned on in a 1-2-3 order. No matter which switch is operated first, the no. 1 load is turned on. The second switch to be operated turns on the no. 2 load, and the last switch to be operated turns on the no. 3 load. At this point, operating any one of the switches to the "off" position will disconnect the no. 3 load. The second switch to be turned "off" will disconnect the no. 2 load, etc. The schematic for this arrangement is shown in **Fig. 2.**

Other uses for this switching arrangement will no doubt come to mind, such as:

1. Always turn on the SAFE light in a photographic dark room prior to turning on the enlarger.
2. Always turn on the cooling fan ahead of the filament transformer when using air cooled tubes.

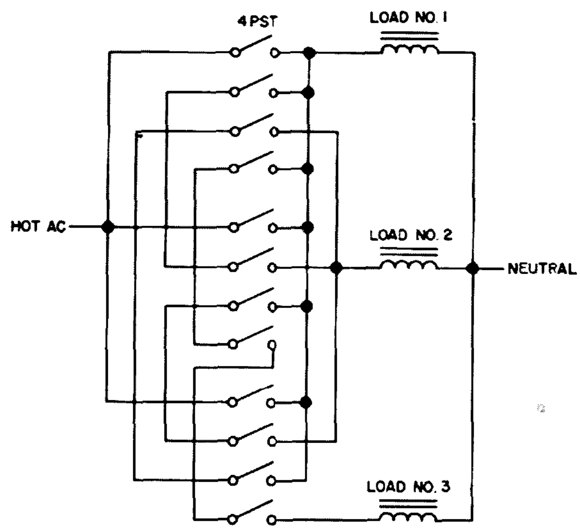

Fig. 2. A three load circuit can be turned on in 1-2-3 order by using this arrangement.

3. Turn on your CB receiver prior to turning on the transmitter. Many CB'ers leave their receivers on for monitoring purposes, and with the squelch operated, it may be difficult for non-technically minded persons—your mother-in-law, for instance—to know whether they turned on the transmitter or the receiver. Just explain to them to operate either switch to turn on the receiver.

4. How about turning on the RTTY power supplies prior to turning on the printer motor?

If the two or more pieces of equipment are widely separated, it might be best to mount the switches and provide outlets in a small Minibox. Be sure to label the outlets 1,2 or 3 to indicate which outlet will energize first, second or third. Plug the equipments into the Minibox and connect the Minibox cord to the electrical wall outlet.

You can also fool your friends with such a box. Plug two or three lamps, as the case may be, into the outlets and let them guess which switch controls which light.

. . . W7CJB

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BACK TO MOTHER EARTH THE EASY WAY

Here's an easy way to let hydraulics (via a garden hose) do the working to establish a good ground connection for home station or antenna array.

The importance of a good earth ground to an amateur radio station was iterated in QST (Aug 1970, p.38). The point is an important one. Improper grounding can cause weird radiation patterns, severe energy losses, and in some cases a serious shock hazard to the operator. QST's solution to the grounding problem is an excellent one: a 10 ft length of galvanized iron rod, sledgehammer-driven into the ground.

My problem is that I have had difficulty finding 10 ft tall acquaintances willing to come over and wield the sledge.

The solution, it turns out, is simple. From your neighborhood hardware store, buy a length of ½ in. rigid copper pipe and a brass female hose connection to match. While you're there,. pick up a bit of solid solder and a length of the leaviest wire you can find.

Use a torch to solder the fitting to one end of the pipe. Clean the pipe and fitting, tin the pipe all the way around with the solid solder, and put the preheated fitting in place. As it's only temporary, the joint needn't be "plumber approved."

The site for the ground rod should be chosen to give a short run to the shack (or in the middle for an array) and to have overhead clearance to wield the 10–20 ft pipe for insertion. It should be more than a foot or so from the basement wall to insure clearing the footings, and with luck, it should be within hose-reach of the nearest

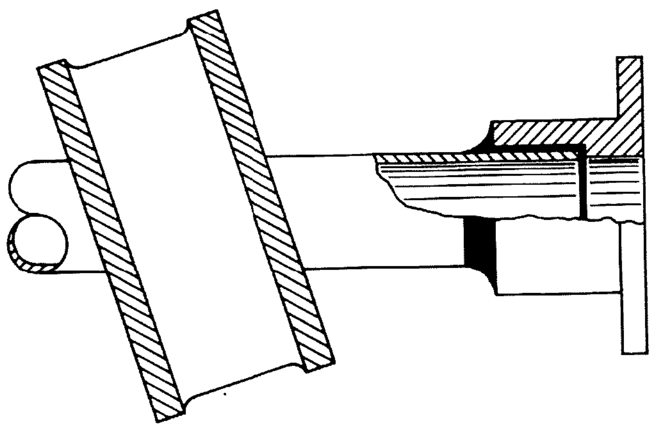

Fig. 1. Female hose connector is sweat-soldered to rigid copper ground pipe. Solder is shown in solid black. Use a blowtorth and plenty of heat. If the hose coupling is forgotten, it can be easily slipped over the plain end of the pipe after the soldering is finished. Soldering in a pipe to pipe coupling for a longer ground rod is similar although less convenient because the pipe will be vertical. Have a friend hold the upper pipe.

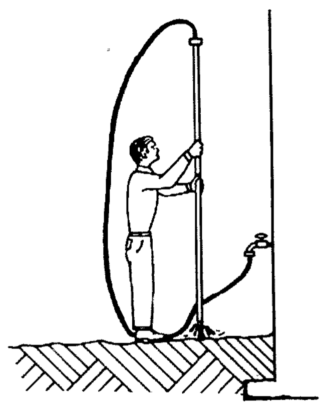

Fig. 2. Insertion of the ground rod. The flowing water will "erode" a hole out ahead of the pipe. The pipe should be started far enough from the wall to miss the concrete footings if they are present. Stop dropping the pipe (and shut off the water) before the top of the pipe is even with the ground to ease removal of the coupling and soldering of the bus. After the bus has been installed, stepping on the pipe will force it down to ground level.

outdoor faucet. Hook up the hose, turn on the water full blast, and with the hose-end of the pipe in the air, drop the pipe straight into the ground. It will sink with a minimum of effort as the flowing water bores the hole ahead of it.

Judicious wiggling will clear most underground obstructions. If you hit one too big to pass, lift the pipe out and try again with a new hole. Leave about a foot of pipe sticking out of the ground.

Unhook the hose, let the water drain away, and unsolder the hose connection. The bus wire can now be soldered to the top of the pipe while the solder is still melted. Foot pressure on top of the pipe will now drop it even with the ground where it will pose less of a danger to kids and burglars sneaking around outside the house in the dark.

The ground bus should be routed to the shack by the most direct route, keeping in mind that it is an rf connection as well as a dc one. Many plush installations run the ground bus directly to a grounding bar, which may be fitted with pin sockets or binding posts, and runs across the back of the work table.

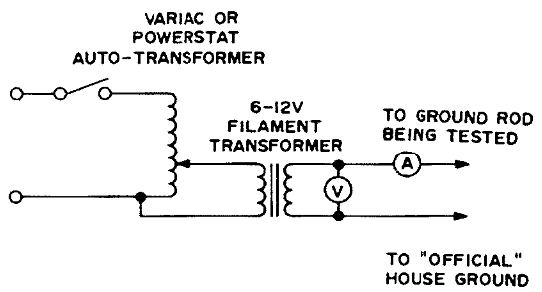

Fig. 3. Cheapie circuit for checking the ground if you don't have a "megger" handy. Voltmeter should read higher than the output of the filament transformer. The ammeter should read about one amp full scale. In addition to lowering the voltage, the filament transformer provides isolation between the line and ground. Don't try this circuit without it. To test the ground, set the autotransformer to zero and close the primary switch. Slowly turn the voltage up while watching the ammeter. When you get an ammeter reading like 0.5–1A, note the corresponding voltage and shut off the power. Resistance is calculated from Ohms Law (R = E/I). 25Ω or less and you have a good ground. A higher resistance may mean that the "house ground" doesn't get to the local soil, and the ground rod is still okay.

After the rod is installed, it may be some time until the soil resettles around the rod. This action can be hastened by gently flooding the area with water, as with a lawn sprinkler, and by tamping the area around the rod with a broomstick.

Checking the effectiveness of the final installation can present a problem, in that if you had a really good ground to begin with, you wouldn't have put in another. Probably the best reference is the house ground, used by the power and telephone companies, and connected (the green lead) to each box housing an electric outlet or switch (it says here). An ordinary ohmmeter is useless for this measurement. Stray electric fields can build up voltages that, with a high impedance instrument, can be positively frightening. Rather, connect a low voltage source such as a variac-fed filament transformer in series with an ac ammeter, and hook this between the house ground and your ground. Monitor the applied voltage with a voltmeter and compute the resistance to your ground using R = E/I.

If the ground doesn't seem to be as effective as you'd like, there are three remedies. For the short term (perhaps longer with luck) soaking the area around the ground rod with water should increase subterranean conductivity. If this doesn't help, add salt. Copper sulfate is good if it is convenient, otherwise table salt is fine. Spread a pound or so around the rod and soak it in with water. The last resort is a longer rod (or another separate ground rod). To lengthen the rod, merely lift it out of the ground a bit, unsolder the bus lead and replace it with a coupling. Solder on another length of pipe fitted with the hose connector on the other end, and let 'er go.

Unfortunately, grounds, like everything else, deteriorate with age. If salt is used, it eventually leaches away, and often the pipe will build up a high resistance layer. Check the ground resistance once a year or so, when you "pull maintenance" on the rest of the gear in the shack. If you maintain the system this way, you too will be able to tell your friends that you are "well grounded" in amateur radio.

. . .WA1FHB■

3 dB for 3 bucks

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Many of us sometimes get involved in rather elaborate antenna or amplifier projects in order to improve our signal by only a few dB. Some projects, particularly antenna ones, can benefit both transmission and reception and so the cost and effort involved might be considered more worthwhile. However, when a project provides only a potential improvement on transmission, a "plateau" is often quickly reached beyond which the dB gained to dollar ratio becomes very unfavorable.

This article explores one very simple and inexpensive means by which one can usually still gain a few dB of transmission effectiveness with any SSB equipment setup. If one has already glanced at the circuit diagrams, it may give rise to the idea that only simple "old hat" 300–3000 Hz audio response restriction is going to be suggested since the circuits are simple tone control types. However, that is not the case. Usually the audio and rf filter circuits in any modern SSB transmitter already sharply limit the audio response below 300 Hz and above 2500–3000 Hz. Many "communications" type microphones are also frequency response limited. Within the frequency response range, great care is also usually taken to insure that the response is "flat," on the theory that no narrow group of frequencies should restrict the overall peak power input. All frequencies are not equally effective in conveying understanding and if the frequency response could be properly tailored to favor such frequencies, improved transmission will result over a "flat" audio response. No increase in the power input or output of a transmitter will result from such audio response "tailoring" but better use will be made of the available power so that under *weak* signal conditions an apparent improvement of several dB in transmission effectiveness will usually result.

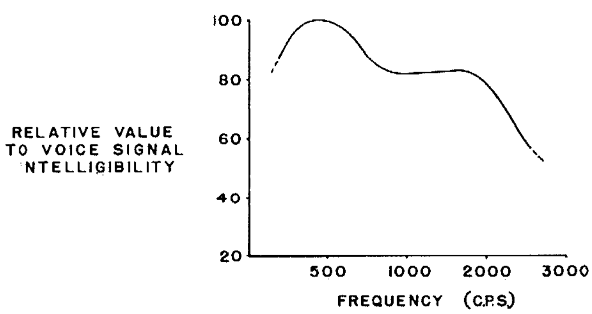
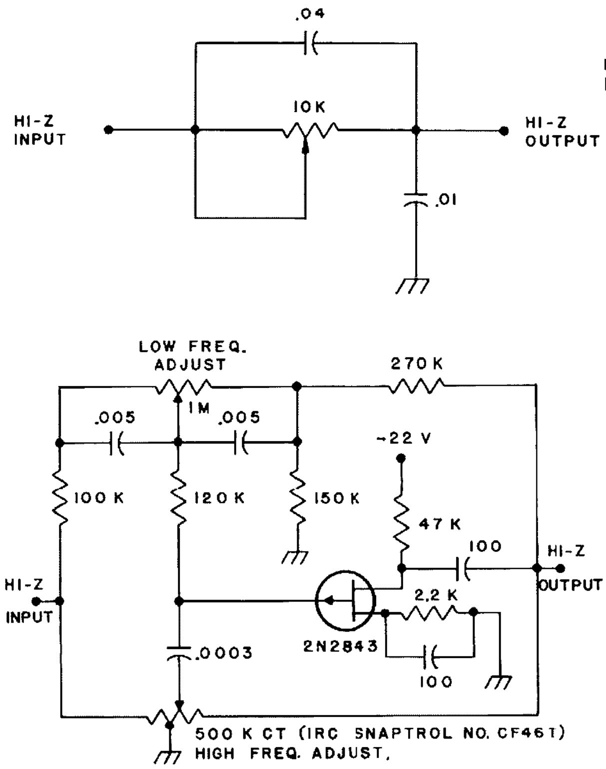


Fig. 1. As shown in this graph, all frequencies in the 300–3000 CPS range do not contribute equally to voice signal intelligibility. A completely "flat" audio response in a transmitter does not, therefore, provide the best voice signal effectivness.

Basic Concept

Many studies have been made concerning which frequencies are the most effective in conveying clear voice communications under both noisy and quiet conditions. Many such studies were made for the development of vocoders, for instance, where only selected portions of the speech frequency spectrum may be selected to eventually develop a composite narrow-band voice signal. Figure 1 is a generalized curve showing the relative value of each frequency in conveying clear voice communications. The very low frequencies are not extremely effective but there is a very interesting peak in the broad range of 375–550 Hz. Higher frequenices are also important until about 2000 Hz and then there is a rapid decrease in the relative effectiveness of still higher frequencies.



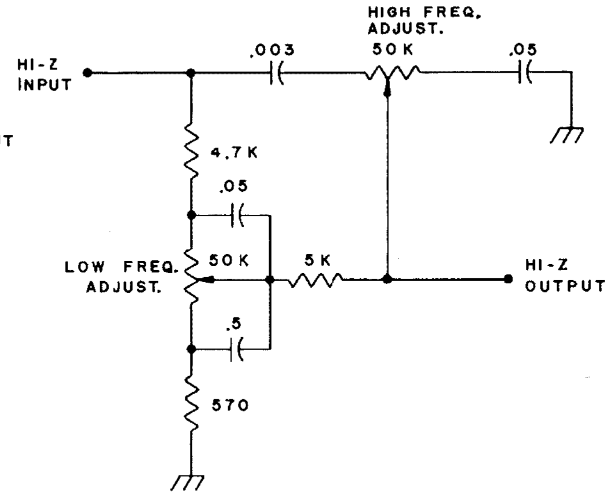


Fig. 2. Various audio "tailoring" filter circuits which can be constructed for about $3 or less. They can be inserted between the usual high impedance microphone and a transmitter or between the output of a compressor and the audio input of a transmitter.

A filter that would correct a "flat" response to conform to Fig. 1 would have to exhibit a sharply rising response below about 500–600 Hz and again from the 500–600 Hz mid-point, a gradually rising response for higher frequencies. Unless the transmitter af/rf circuits provided the necessary total bandwidth restriction, it would also have to have a very sharp cutoff below 300 Hz and above 2500–3000 Hz. Assuming that the latter function need not be provided by an auxiliary filter, many simple audio shaping circuits can be used. Fig. 2 provides some examples.

The circuit of Fig. 2A is about as simple as one can get. It can be inserted directly in a high impedance microphone lead or in the lead between a compressor or preamplifier output and a transmitter. The loss it introduces can easily be taken up by the reserve gain of most transmitter microphone amplifiers. The circuit of Fig. 2B is really a standard high-fidelity tone control unit but quite useful since it provides separate low and high frequency boost and attenuation. Such a circuit could easily be assembled on a piece of Vectorboard and placed inside a compressor enclosure. Miniature PC board trim potentiometers can be used since once initially adjusted, the unit can be left alone. The circuit of Fig. 3C using a Siliconix FET provides even more elaborate and exact frequency response "tailoring" to assemble the circuit in a Minibox enclosure using a battery supply (the current drain is less than 1 mA).

Adjustment

No matter which network is used, it generally does no good to set it up for proper frequency response using test instruments. It must be remembered that it's the total integrated audio response, starting at the microphone, which must be set for maximum effectiveness. Individual operator's voice characteristics and operating habits can also influence the adjustment. Some microphones change their frequency response, for instance, depending upon at what distance they are used, although the variation is not usually large with a good microphone. So, an on-the-air test is us-

ually the best means of adjustment. The power level that is used is not important and, indeed, for proper adjustment the transmitter output level must be reduced or the rf gain on the cooperating station's receiver turned back to simulate a *just barely* readable signal. The adjustment process is simple but it does require time and patience. The same number sequence should be repeated by the operator while each one of the two potentiometers of the filter unit is independently adjusted through its range (or the single potentiometer of the circuit of Fig. 2A). The receiving operator must continually keep the receiver rf gain turned back to simulate a very weak signal while he tries to distinguish which filter settings produce the most effective transmitted audio. Often, it will be found helpful to make provisions for removing the filter unit so a direct comparison can be made between the original audio setup and a setup using the filter set to what appears to be its optimum response. Care must be taken that the transmitter is modulated to the same power input level in each case. The effect of the filter will not be noticed by an increased "S" meter reading at the receiver but by a very distinguishable increase in the intelligibility of the audio under weak signal conditions.

Results

The author experimented primarily with the filter circuit of Fig. 2B used after a compressor. A good quality crystal microphone was used. After adjustment, comparison reports consistently indicated an increase in signal effectiveness equal to increasing the transmitter power level by several dB.

As long as one is willing to devote a bit of time to the adjustment process, audio "tailoring," by use of one of the filter units presented, will be found to be one of the easiest ways possible to add extra dB to an SSB signal. No internal modifications to a transmitter are necessary and usually passive circuitry can be used so that no power source is necessary.

. . .W2EEY/1■

THE HAMS' PUBLICITY PRIMER

When radio amateurs perform valuable public service to the community it's a good time to spread the word. It helps to know how to "tell it like it is."

Is amateur radio getting poor marks for the way it tells its story to the public?

You bet your sweet donkey!

Most of us know about the many public-spirited activities performed by hams every day. But the *public* isn't so well informed, and it's my opinion that we have no one to blame but ourselves for this "communications gap."

To bridge this yawning chasm we've got to wake up to the need for good, very basic publicity. It could be that if more hams had a working knowledge of how to tout our accomplishments, the public would

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Radio amateurs reported special election issues directly from cities and towns to the Vermont Educational Television studios during the last election.

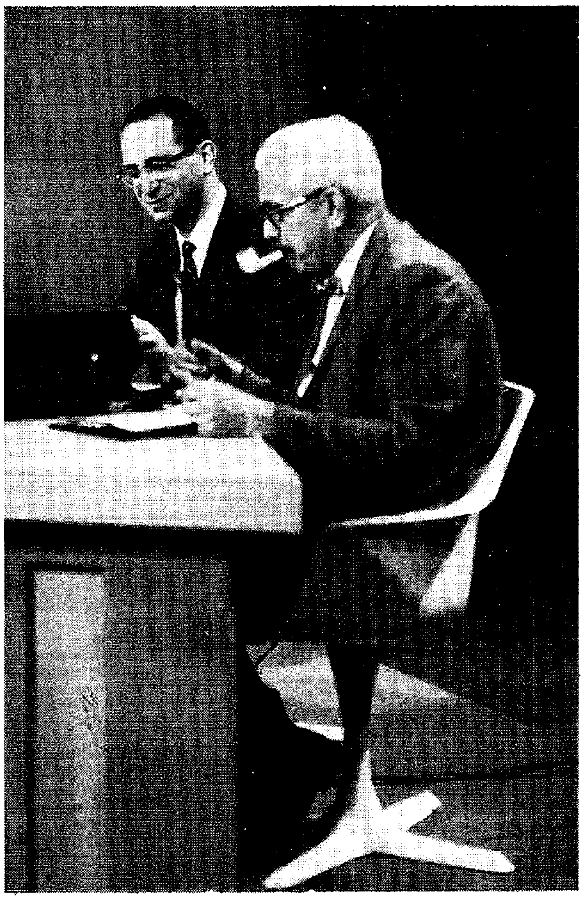
Two political commentators on the left stood by as Jim Viele (W1BRG) and Joe Frank (W1SOV) received returns from mobile stations through Vermont 2 meter FM repeater stations on Mt. Mansfield and Killington. Ham radio techniques provided service several hours faster than normal wire services.

have a far better understanding of our significant contributions.

Why should we worry about it? We hams are licensed to operate in the public interest; our frequencies aren't granted solely for our own amusement. There is also a shortage of frequencies that's causing our neighbors in their squeezed channels to eye our bands enviously. Some of them see our bands as elbow room for *their* services and consequently they're running mimeograph machines far into the night turning out press releases jammed with reasons why it should be "them and not us."

We've got to justify our existence whether we like it or not! What happens to our frequencies may well be determined by public opinion and how it's impressed upon regulatory agencies and congress. Let's face it – public opinion is formed to a large extent by what people learn from newspapers, radio, and television. If we're not telling our story in a positive way, who will? Public relations is sorely needed!

What's public relations? One definition is simply: "Good performance publicly acknowledged and appreciated." Or how about: "Doing good and telling about it."



Jim Viele (foreground) and Joe Frank report special returns from all over Vermont during the 1968 election over Vermont educational television network. Hams from all corners of the state reported directly to the studio with mobile stations on 2 meter FM frequencies through the Mt. Mansfield and Killington repeater stations. Report on returns were televised every few minutes as cameras were turned on the ham station. This technique made it possible to beat out normal wire-service reporting by several hours.

We certainly qualify for the former, but fail in the latter!

The scope of this article isn't in what to do, but rather how to tell about it. Every ham has a chance to help out, and it certainly doesn't take a large, megabuck-financed national organization to do the job. We're talking about grass-roots publicity; zeroing in on *your community* with the radio amateur's story.

While it's true that radio clubs have more going for them in terms of activities to report – field days, traffic, radio classes – many equally newsworthy events are happening to individual hams all the time.

Thanks to the efforts of Harold (K2DLD) these Schenectady, N.Y., parents were able to phone patch with their sons and daughters during a singing tour of South America. This good example of public service resulted in favorable newspaper and television coverage.
Photo: Schenectady GE News

Recognize news when it happens! To be effective, you've got to have a story that will interest the news media. Since most news editors are pretty hard-nosed about what they accept, it helps to develop a feel for what will "sell."

Your dictionary may tell you that news is "something that just happened," but there's more to it than that. Wilbur Schramm once wrote in the *Journalism Quarterly* that news "exists in the minds of men." He said that it's not the event but the reconstruction of the framework of that event. It means writing a news story in a way that's meaningful to the reader.

There are zillions of things newsworthy happening within amateur radio throughout the year, and many of them can be quite valuable when multiplied by news media. The unusual, dramatic, and exciting things are first choices. Hams handling emergency traffic during storms, floods, or fires make news, for example. So does a holiday traffic handling project for GIs overseas. Field days and emergency tests qualify, and so, too, does a club radio class.

Just as various bands provide hams with various degrees of "reach" for their signals, so, too, do news stories vary according to their subject matter.

Some things make good copy for your local newspaper, such as the ladies night club meeting announcement with an accompanying list of XYL committee members. Other stories have so much inherent drama that they command the attention of a wider circle of news outlets, such as the Alaskan earthquake traffic handled by hams.

Before contacting the press about important ham happenings it's important to organize the facts. If the event is one in which you're a participant, the job is easy. Otherwise, you've got to gather the facts from others before writing up the event.

For the radio club publicity chairman this means legwork or landline calls, although the job can be made much simpler if he publicizes his telephone number in the club bulletin so that members automatically call when things happen.

After securing the facts, the task is in organizing them in a logical manner in a news release. The key here is in following proper form and style so that the information is in familiar, ready-to-use format. Editors are human, and giving them something requiring little or no major translation or rewrite may result in publication instead of the circular file.

Most news releases contain the same basic elements: some heading designating the issuing organization or individual, a release time if it's dated material, a date of issue, contact information, and the actual news matter.

Taking it from the top, a letterhead is usually the best vehicle for carrying news, since it adds an air of authenticity to the document. Radio club stationery is ideal for the job. If you're not representing an organization or can't get a letterhead, you can use white bond. In either case, type the words *News Release* across the top or flush with either right or left margins.

Next, date the release. This means the date you're issuing the information and not necessarily the date of the event mentioned in your text. On current, topical news items type the words *For Immediate Use* which indicates that yours is dated information.

This news photo catches the action of the radio amateurs' role in supplying communications for the Albany to New York Outboard Motorboat Race. Hams provided communications over the entire 155-mile route via 75 meter SSB and 2 meter FM via repeater. Note the identifying sign positioned in the scene. Such public service activities are good newsmakers.

Photo: W1DQO

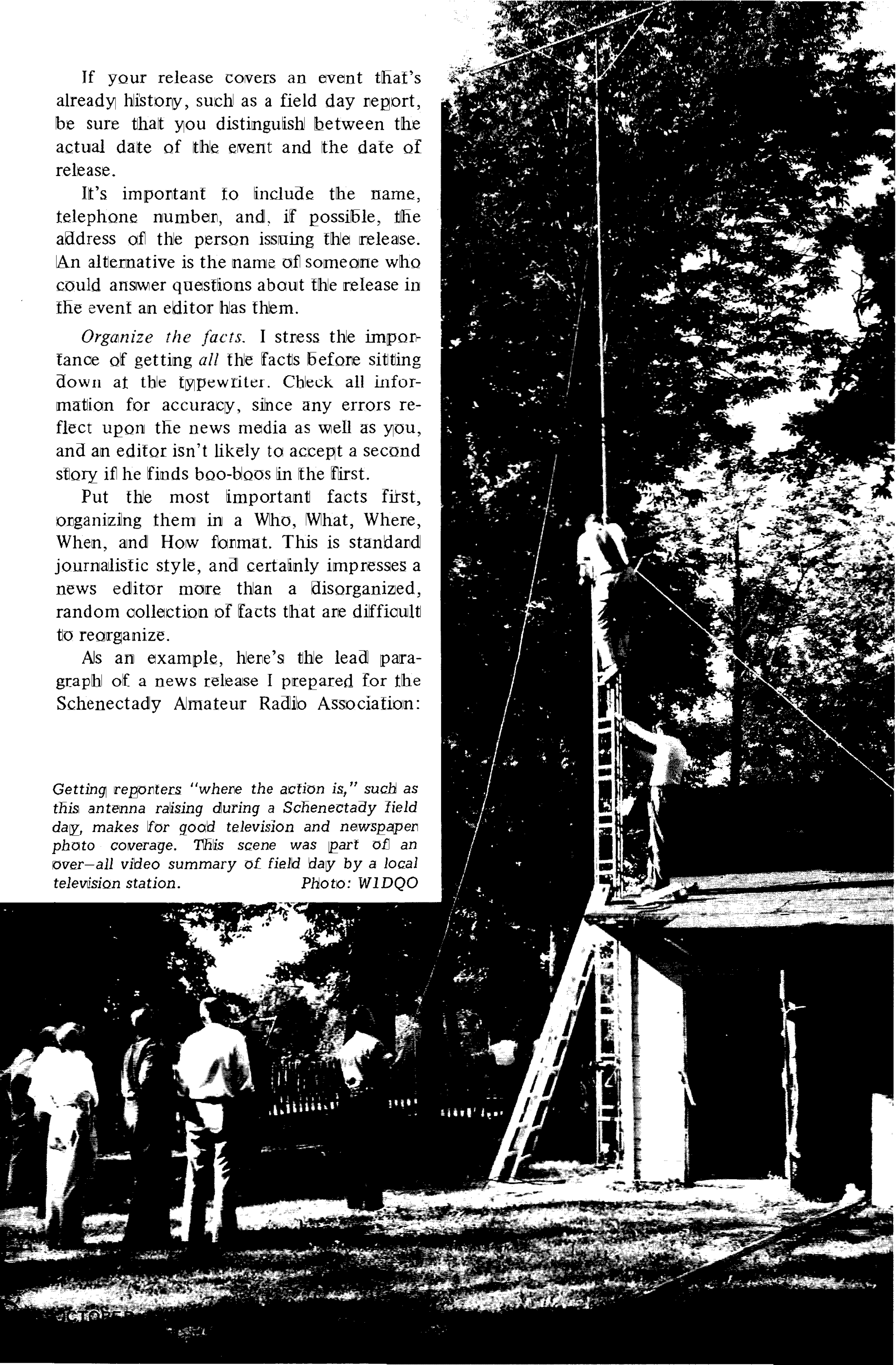
If your release covers an event that's already history, such as a field day report, be sure that you distinguish between the actual date of the event and the date of release.

It's important to include the name, telephone number, and, if possible, the address of the person issuing the release. An alternative is the name of someone who could answer questions about the release in the event an editor has them.

Organize the facts. I stress the importance of getting *all* the facts before sitting down at the typewriter. Check all information for accuracy, since any errors reflect upon the news media as well as you, and an editor isn't likely to accept a second story if he finds boo-boos in the first.

Put the most important facts first, organizing them in a Who, What, Where, When, and How format. This is standard journalistic style, and certainly impresses a news editor more than a disorganized, random collection of facts that are difficult to reorganize.

As an example, here's the lead paragraph of a news release I prepared for the Schenectady Amateur Radio Association:



Getting reporters "where the action is," such as this antenna raising during a Schenectady field day, makes for good television and newspaper photo coverage. This scene was part of an over–all video summary of field day by a local television station. *Photo: W1DQO*

"More than 150 Schenectady amateur radio operators will participate in a simulated emergency test this weekend as a part of a nationwide exercise conducted in cooperation with the American Red Cross and Civil Defense agencies. . ."

Following this lead paragraph, the release went on to outline additional facts and explanatory details of the story. Among them: who was sponsoring the radio activity, the reason for the emergency test, messages to be handled, and quotes from the radio chairman and local Red Cross chapter chairman.

Try to "sniff out" the most important or dramatic part of the story for the lead paragraph, and then fill in the additional facts of the story as the release goes on. Grabbing someone's attention is the first hurdle a writer faces, and it insures that more people will read it than pass over it.

The more professional-looking the release, the better are its chances of being considered for publication. Here are some of the basics:

- Type the release on good white bond, double-spacing throughout.
- Stick to the facts, avoiding opinions that seem to editorialize.
- Use plain English, good grammar, and common phrases while avoiding ham jargon that wouldn't be understood by the general public.
- Keep sentences short, and eliminate extra words – crisp style is a plus.
- Use full names and addresses when mentioning individuals. Call letters aren't too important for local use but naturally should be included in stories sent to radio magazines.
- If your town has several news media, be sure to release your news simultaneously. *Editors are irritated to spot a story in a competing news medium before they've seen it.* (Amen! – Ed.)

Including a photograph with a news story is an important "extra" that increases the chances that a story will be used. But, since the cost of preparing printing plates of photographs is considerable, editors are fussy about what they'll accept. It's got to be good!

OUTLETS TO CHECK

- **Daily newspapers**
- **Local radio & television stations**
- **Weekly newspapers**
- **Company magazines (if your story involves employees of local firms)**
- **Chamber of Commerce magazines**
- **Amateur radio magazines**
- **School newspapers (if your story includes student participation)**
- **Major metropolitan newspapers that publish state-wide news features that include your community.**

Unfortunately for most of us, this means shelling out a few bucks for a reasonably competent photographer who can come up with professional-quality prints. Polaroid shots don't make the grade.

What makes a good photograph? You can judge that by looking over some of the popular national magazines. Visual *interest* is the key. Action shots showing people *doing* something are much more desirable than the standard shot showing people lined up like phased verticals and just "standin' around not doin' nothin'."

If you're sending along a newsphoto with your story, be sure you identify it as to subject matter or in terms of "what's happening." Attach this information in a photo caption, and if there are people, identify them.

Some news events lend themselves to coverage by radio or television. Prime subjects include activities such as field day in which the action and immediacy of the moment combine to provide ideal broadcast stories. Highly visual events like antenna raising, generator checkouts, rig setup, and actual on-air situations are great on camera. If your local TV station can spare a sound camera, it would also be possible to interview the FD chairman who could explain the action and the significance of the drill. The drawback to video coverage is that most stories must be boiled down to about a minute, so every scene and every word count.

NEWSWORTHY ACTIVITIES

- **Emergency traffic handling**
- **Distress calls handled**
- **Emergency drills and field day**
- **Interesting 'phone patches**
- **Public service networks**
- **Radio classes**
- **Furnishing communications for special events (parades and election returns)**
- **Special club programs**
- **Speeches on ham radio to civic groups**
- **Radio exhibits in schools**

When you approach a broadcast station, remember that most of them are quite busy and follow rather complicated logistics in setting up stories in which a cameraman is involved. So if you're interested in having them cover your event, give them plenty of advance notice. By mail, include a cover letter with your release pointing out the importance of the story and offering your help in setting up any film coverage. Don't try to shove the story down the throat of a news editor, however. Editors decide if the item is going to fit their schedule, and even if they don't agree to do a film story they may still mention it in their newscasts.

Give the press a "Fact" sheet. Busy editors are willing to learn about your organization, but they want the basic facts boiled down to a few clearly written paragraphs. In short, the "nitty gritty" of it all. A typical fact sheet could contain the following elements:

- Why your organization was organized, hopefully stressing the public service aspects of amateur radio.
- Where your organization is located, the geographic area represented by your members, and the headquarters address. Club call letters may be added where appropriate.
- Who your members are: A good spot to emphasize the fact that hams are licensed by the government only after passing stiff exams on code, theory, etc. This distinguishes the amateur radio organization from CB groups.
- How you function: Emphasize here any public service activities in which the group regularly engages, such a traffic handling, radio classes etc.
- What you've done: A summary of noteworthy accomplishments could be included if the club has been around long enough to build up a scrapbook of good deeds.

One word of warning: Remember that yours isn't the only news passing the news desk and that sometimes your story may never see print or get on the air. There's competition for news coverage, and this QRM can sometimes drive your story right out of the running!

Don't be discouraged!

Even if you've labored over a news release all evening (and missed a beautiful band opening or DX) you really haven't labored in vain. Send the story to the amateur radio magazines if appropriate, adding the call letters of those involved and any ham jargon that had to be excluded from the local version.

If your club has a bulletin, ask the editor to consider a version of your story for his next issue. Editors are always hungry for good copy!

Keep a file of all news releases. Such a file is handy in the future when writing similar stories, since the writer can refer to it for style and approach.

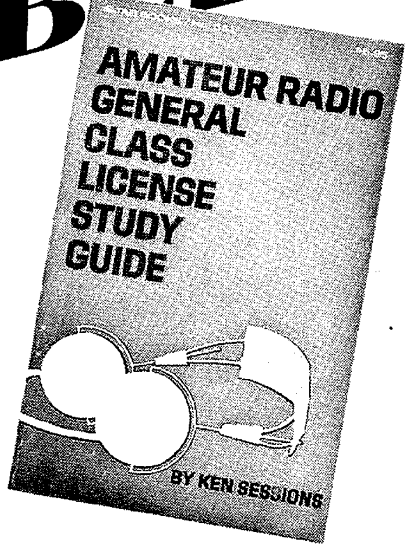
Thanks. When your local news media have used several of your stories, it's not a bad idea to write them a note of thanks. Editors appreciate this.

If you're the publicity chairman of a radio club, add some information as to how a newsman can reach you. Sometimes an active newspaper or broadcast station will go looking for interesting feature stories, and they may think of your group the next time they're stuck for an idea. Such things as radio classes for teenagers make good copy.

In summary, tell the story of ham radio's positive contributions, and tell it often! It's a sound way to build an equally sound public appreciation of our efforts.

Who knows? When the going gets rough, we may need this good will "savings account" more than we realize. WB2FBF■

IMPOSSIBLE?



No! Just Difficult.

It is not impossible to pass the General (or Technician) Class amateur license exam if you haven't read this superb license study course. Dozens of amateurs have managed, though some have had to make several $9 stabs at it to get by. Now, being realistic, isn't it only practical to invest a lousy $5.95 in this incredible book to make sure you don't blow that $9 bet (plus all the inconvenience, expense, nervous frustration and embarrassment of failure) that you can pass the first time around?

In the past most amateurs have relied upon a memorization book put out by a small group of inactive professional amateurs and the FCC statistics tell the sad story only too well – failure – time after time as the hastily crammed memories blanked out under the pressure of the steely-eyed FCC examiner. Was that a sneer when the flunked exam was announced?

Then along came the 73 study series, prepared by live amateurs – active amateurs – a study course which enabled amateurs for the first time to really understand the answers to the exam questions rather than just try and memorize them. Hundreds (hell, thousands!) of happy users of our Advanced and Extra Class courses have written to say that they got them through the exam slick as a whistle the very first time out. Many report that our courses are so simply written that they didn't even have to study them, just read them through and they understood what they had been afraid was going to be engineering-level theory.

This General Class course has been gathered up into one handy book and is now available at the ridiculous bargain price of only $5.95 postpaid. It fills well over 300 pages, is profusely illustrated, and lists all of the latest FCC study questions, and even has a really great index. A steal at $5.95.

If you plan on passing this tremendous book on to your heirs you might want to spend the extra and invest in the hard cover model, handsomely gold embossed for $8.95.

Send to:
73 Magazine, Peterborough NH 03458

General Class License Study Guide

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City ______________________ State __________ Zip __________

. . . Some notes on the . . . SWAN 350 SWAN 350 SWAN 350

Paul K. Pagel K1KXA
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Thompsonville CT 06082

If you own a Swan 350 or are thinking of purchasing one on the used market, the ideas put forth in the following article should be of interest to you. Briefly, it is a summary of modifications I have made to my Swan 350, some of which take only moments, others which take an hour or two, but none of which are very difficult.

I've had my Swan 350 since December 1966, when I purchased it on my last trip to the famed "Radio Row" section of New York City. It has brought me many good hours of hamming, mostly on 10 meters. What a difference between it and the receiver I had been using!

Like most hams, I eventually began to think of some small modifications I would like to see in it. This urge became even stronger with the advent of the Swan 500, 350C, and the 500C, which had a few more goodies and some circuit changes not incorporated in the 350. Since I was in no financial position to buy new gear, I decided finally to dig into the Swan. My wife did not encourage this decision, to put it mildly, but I was hoping not to mess up a piece of good-running, expensive gear.

The first trip into the belly of the Swan had as its purpose the installation of components necessary to utilize the remote vfo. This will not be detailed as it is a factory modification readily available. The successful completion of this project encouraged me.

AM Reception

The next change I wanted to make was to be able to copy an AM signal without the beat note produced by the product detector when the signal drifted. On this occasion I wrote to the Swan company to inquire if they had any easy way of doing this. (Swan, by the way, has an excellent customer service representative in Mr. L. Whitley K6PKC.) The modification I received was simply to install a switch to unground the grid resistor of the carrier oscillator, R1401. The ground end of the resistor is lifted and wired to the arm of an spdt switch. One end of the switch goes to ground and the other to the terminal marked "K" on S2, the RECEIVE/TUNE switch.

I mounted my switch to the left of the PTT/VOX switch underneath the S-meter. Originally, it was mounted on the rear apron, but I soon tired of having to reach behind the rig to get at it. A miniature Radio Shack toggle switch was used. Since this requires only a small hole, it makes the

job easy and is not messy at all. When drilling the hole, it might be a good idea to use a speed control on the drill and also to centerpunch the hole location before drilling. That way you won't slip and mark up your panel meter.

In use, you may receive AM without the annoying heterodyne produced when the signal moves off frequency slightly, but you still maintain SSB *transmission* or, if you have inserted carrier, single-sidebanded AM. I have used this method of receiving AM and it works well for the purpose I intended, on a strong local signal. It does amount to forcing the signal through the product detector, however, and weak AM signals won't quite make it.

Schematic Discrepancies

In answer to one of my many requests for information, Mr. Whitley forwarded the schematic of a Swan 500, the model immediately succeeding the 350, plus Service Bulletins 9A and 10. Comparing all this information to the schematic I had in my instruction manual and checking the wiring itself, I found that the schematic in my manual did not fully agree with the particular unit I had.

On earlier model 350s, there was a wire running from pin 9, of V13, the balanced modulator over to a terminal on the RECEIVE/TUNE switch. This wire was *not* installed on later 350s. Although the wire had been removed in my unit, the schematic indicated the wire existed. The Swan people removed this wire *to reduce a spurious radiation while operating in the lower portion of the 15 meter CW band*, as quoted from Service Bulletin 9A. You can readily tell if this wire is there or not. If the wire *is* there, you will have carrier insertion simply by rotating the RECEIVE/TUNE switch to TUNE. If the wire *is not* there, you have to insert carrier with the CAR. BAL. control every time you tune up and then balance it out if you're working SSB.

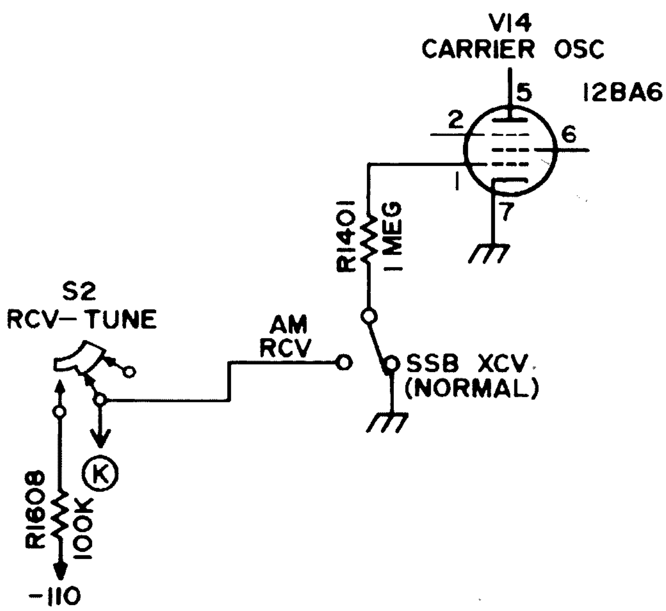

Fig. 1. This diagram shows the changes made in order to copy AM without a beat note caused by drifting of the signal. The switch is mounted on the front panel below the S-meter to the left of the PTT/VOX switch.

On earlier 350s, produced before June 1966, overheating of L306 (an rf choke in the plate circuit of driver V3) caused a loading problem on one or two bands, according to Service Bulletin 10. The bulletin states that overheating of this choke

would occur if a momentary short between the plates of the variable final grid capacitor existed. On later models, a 0.002 μF capacitor was installed between the rear

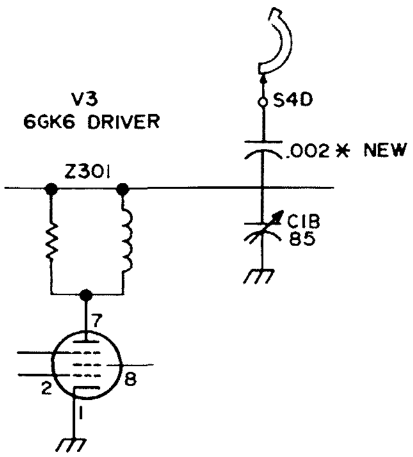

Fig. 2. This is the change incorporated by Swan on the later model 350s to prevent overheating of rf choke L306. (No connection between the junction of the capacitors and the driver plate circuit, please.)

section of the variable capacitor and switch section S4D. The fixed capacitor, although not indicated on the schematic I had, was there. You can easily tell if it is in your unit (if you're doubtful as to its age) since it's visible from the top of the chassis connected between the rear section and a nearby terminal strip with a wire going to the underside of the chassis. This capacitor was indicated on the 500 schematic I received and there labeled as C308.

While prowling through my 350, I noticed the connection for L403, the rf choke on the output end of the *pi*-network hadn't been soldered. Although I never experienced any problems because of it, and don't imagine anyone would, a touch of solder put my mind to rest. It is a safety feature. Should one of the plate-blocking capacitors C415 or C416 short, this would put 800 to 900V dc on the antenna connection. This choke insures that the fuse, circuit breaker, or power supply goes first instead of you. Its presence doesn't bother the rf going out to the antenna.

Another possible "zapper" is located on the VOX accessory socket on pin 3. It's got 275V dc on it. No, it's not for the transistors! Pin 3 is the takeoff for receiver audio for the VOX unit and is derived directly from the plate of audio output tube V12, without the use of a blocking capacitor. Since all you want, if you're using the VOX, is the audio, put a 0.05 μF ceramic in there and keep the dc off pin 3. You could use a paper or Mylar, but they're physically large.

There is an 18 MHz trap on L601 on later Swans. Again, my schematic did not show it, but it's in there. Inside you'll see a small ceramic trimmer and coil mounted on L601. The trimmer tunes the trap, not L601! It's just nice to know what the extra parts are for.

While talking of trimmers, possibly some of you have had fun looking for the 10 meter neutralizing capacitor. It's the small trimmer near the shaft end of the 20 meter neutralizing capacitor between the bandswitch and the 10 meter driver coil. A two-lug terminal strip is also nearby, which is the ground lug for the 10 kΩ, 10W resistor in the screen circuit of the finals. Remember to reneutralize the finals when you replace them with new ones.

VHF Operation

Last winter I had the urge to go on 2 meters. Since the 350 is the only receiver I have, I had to run the converter into it, using the 10 meter band as the i-f. I got tired of worrying about blowing the converter and possibly the finals if the transceiver were accidentaly keyed with the converter hooked up to the antenna jack. So, I installed a single-hole-mount BNC connector on the rear apron between the power plug and the accessory socket. The wire from the center conductor of the connector was hooked to L604 where the wire comes from K2 relay operating arm to the lug on the form of L604. This eliminates the possibility of a couple hundred watts of SSB being fed into the converter front end.

Grounding

In the early operating days of the 350, I had a few reports of hum on the carrier

when operating CW on 40 meters. My first thought was power supply problems, but this proved false. It turned out to be insufficient grounding. Although each unit was separately grounded to station ground, the addition of a length of braid between the power supply cabinet and the transceiver chassis cured the problem. A hole was drilled near the VOX socket and a bolt installed with lockwashers and a nut to keep the bolt in place. A second nut keeps the grounding braids in place.

I noticed that the rf gain control became scratchy quickly. I cleaned it, but it again started scratching after a short while. Since the following modification was made, I haven't cleaned the pot once, and that has been over a year. The sensitivity also appears to have come up, but it only *appears* that way because the rf gain control does not have to be opened as far once the modification is installed.

Independent Biasing

Balanced tubes for the finals are not always handy. In fact, I never knew Swan recommended balanced tubes until I wrote to them a while after I had the rig. Unless you have a spare pair around all the time, there may come a time when you'll have to use unmatched tubes if you want to get on the air in a hurry. (Again, Swan is terrific in filling orders promptly.) Chances are you're not going to be able to buy a matched pair locally and the guy at the store isn't going to let you run through a dozen or more testing 'em. That's why I put in separate biasing networks.

This modification takes a little more time and possibly it could be accomplished more easily by some other method, but this is the way I did it. I duplicated the existing network. Probably the hardest part was finding room for the extra parts in the already crowded chassis, but I've got it all mapped out for you so it shouldn't be much trouble at all. You'll need a dual 10 kΩ pot with concentric shafts, a 10 kΩ (1W), two 4.7 kΩ and a 1 kΩ resistor, one 200 μH rf choke or peaking coil, two 0.002 discs, and a 5 or 10 μF 150V electrolytic capacitor – plus a couple of small terminal strips.

Start by removing the bias pot from the rear apron. Disconnect the two wires and the end of R411 and push them aside temporarily. R411 is soldered to a ground lug underneath the 10W power resistors near the bias pot. Solder one end of the

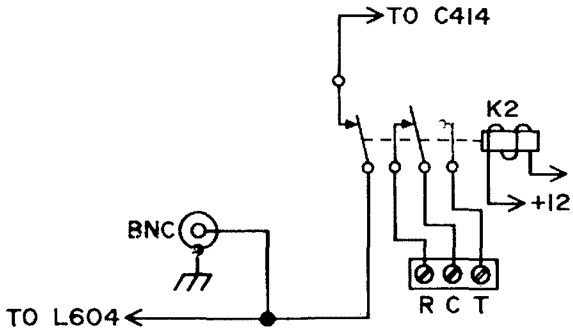

Fig. 3. The BNC connector is mounted on the rear apron between the power connector and accessory socket. This allows injection of signals from VHF converters, frequency calibrators, etc., without the possibility of damage due to accidental tripping of the transmit switch.

new 10 kΩ (1W) resistor to the same lug. Label this resistor R411b on your schematic.

A small three-lug terminal strip with center-mounting lug is mounted under the mounting screw for the barrier strip carrying the auxiliary relay terminals (AUX. RELAY TERMS.). R413b, 4.7 kΩ is connected across the two above-ground terminals. On one end of this resistor, connect C406B and a wire. The wire will eventually go to the bias pot. The other end of C406B is grounded at any convenient spot. (I used the socket ring of V5 socket.) From the other end of R413b, connect R412b, 4.7 kΩ, with insulated sleeving on the leads to prevent shorting, over to pin 7 of V4, the final amplifier socket toward the front. We are going to use the inoperative pins for terminal lugs – there are no tube connections at these pins. At pin 7 of V4, connect C401b, 0.002 μF from the pin to ground. Put sleeving on the 1 kΩ resistor (R402b), and connect it from pin 7 of V4 across the socket to pin 2 of the same socket.

At this point, we must isolate the grids of the two final amplifiers as far as the bias networks are concerned yet allow rf to get to both of them. Do this by cutting the copper strap between V4 pin 5 and V5 pin 9 just enough to allow the body of a 0.002 μF capacitor to fit between the ends of the straps. This capacitor would correspond to C318, so call it C318b. Solder one lead to V4 pin 5 strap and the other to V5 pin 9 strap. Also from V4 pin 5, solder one end of the 200 μH rf choke L404b; the other end goes to V4 pin 2. Try to keep all leads as short as possible.

To insert the dual pot in the chassis hole, it may be necessary to temporarily unsolder one or two of the 10W power resistors. Mount the dual pot and connect the bottom ends of the pots to their respective resistors (R411 and R411b). The wire, white/yellow/green, that was removed from the old bias pot can now be replaced on the center wiper contact of one of the pots and the wire from R413b goes to the other pot center lug. The −110V dc line should be connected to both of the upper lugs on the pots. This completes the modification.

But how, you ask, do you adjust the bias values individually without the aid of a switchable plate current meter? If you pull one tube out, the other will be dead since the filaments are in series. And who wants to stick another meter in there, even externally? Well, if you've stuck with us this far, hang in there 'cause we're going to get to the switchable current meter in the next modification. Temporarily I used an old 6HF5 with good filaments, cut off all the other base pins and used it to complete the filament circuit without drawing cathode current. Sneaky . . . Now you can remove one of the finals, put in the dummy tube, set the idling current with the associated bias pot, remove the operating final from its socket, substitute the dummy tube, put the other tube in its appropriate socket and adjust its bias with its pot. For a check, try inserting carrier to a given level, say 100 mA, and see how the two tubes track for a given setting of CAR. BAL. If they're within 10%, you should be okay. If you check the bias voltage on the two tubes while you're doing the idling current adjustments, you should see a difference in the amount of bias required for a given idling current level if the tubes are unbalanced. If the values of bias voltage are close, the tubes are probably pretty close to being matched in the first place, but chances are you'll see a significant difference. Even balanced tubes won't track exactly 100% over the full range of currents.

The ability to monitor the current of each of the final amplifiers separately can

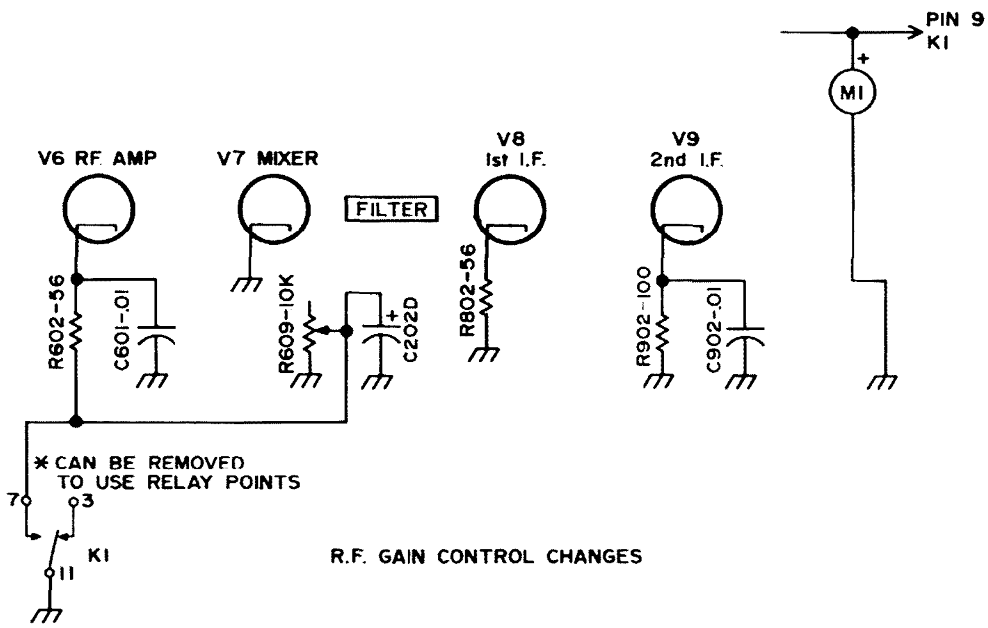

Fig. 4. This eliminates frequent rf gain control scratchiness and gives apparent sensitivity increase.

be accomplished without too much trouble. Since I wanted this convenience, I decided to take the following approach. It has a side benefit in that it allows reading the currents twice as accurately.

By referring to the schematic, you will notice the cathodes of the final amplifiers are connected in parallel, going to ground through two resistors, R408 and R409, both 1Ω (5%) resistors. These resistors are here simply to provide a voltage drop to be read by the 0–1 mA meter used as the combination S-meter and cathode current meter. In this instance, the meter is used as a voltmeter with multiplier resistors R406 and R405. R406 is a 470Ω resistor while the value of R405 is not specified, but in my case is 1.5 kΩ.

Conveniently, resistors R408 and R409 are mounted so that one is at each final amplifier tube socket and not immediately adjacent to one another or tied together. This makes the job easier. Cut the copper strap between pin 4 of V4 and pin 10 of V5. This separates the cathodes of the two tubes from each other but leaves R408 at one socket and R409 at the other. Attach a wire to pin 4 and another to pin 10 of V4 and V5. These are to be routed neatly around the chassis to the front panel to a spot underneath the S-meter where the switch will be mounted.

R405 and R406 are unsoldered from the cathode strap formerly joining the two tube cathodes and this junction of the two resistors is soldered to pin 7 of V5 along with a wire which will also be routed to the S-meter location for connection to the center pole of an spdt switch.

If you remember the AM modification, a switch was placed on the left side of the PTT/VOX switch (facing the rig in a normal operating position). Now we will put the other switch to the right of the PTT/VOX switch to balance the layout. Again, a miniature toggle switch is used. This time, however, the meter will have to be removed to get your fingers in a working position. (The mounting screws are underneath the nameplate which is held on by an adhesive backing.) You will also have to remove the tubes immediately

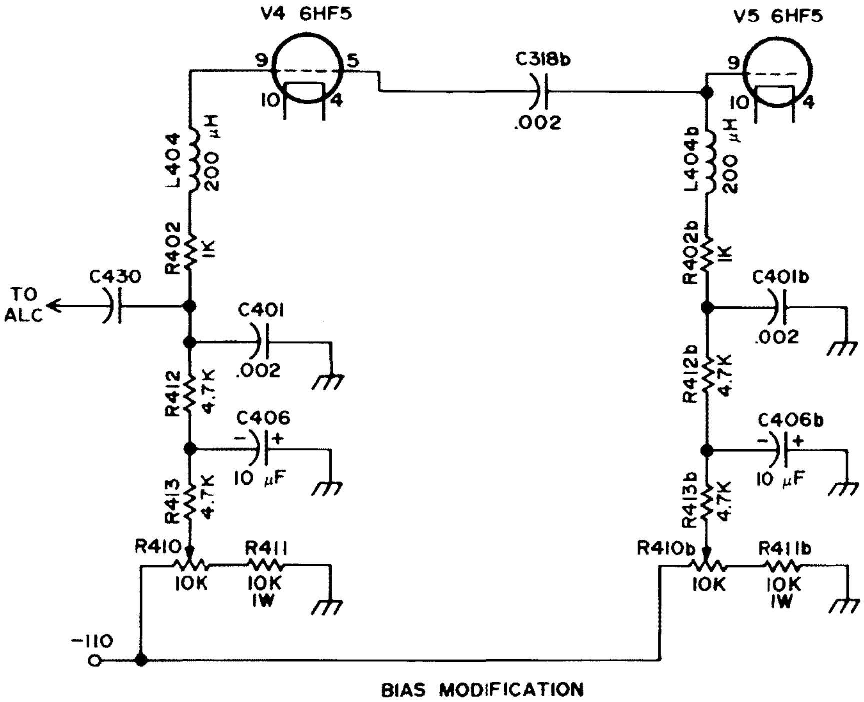

Fig. 5. This allows adjustment of the bias on each tube individually and permits the use of unbalanced tubes in an emergency.

behind the meter. The switch is installed in the same manner as previously described. Here, the switch was installed with the center slightly to the right of center of the letter "O" in VOX. The mounting washer

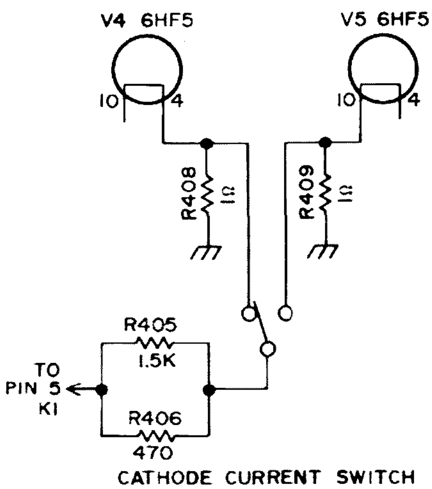

Fig. 6. Hookup allowing monitoring of individual tube cathode currents. The switch is mounted on the front panel underneath the S-meter to the right of the PTT/VOX switch.

that comes with the switch covers the word "VOX" neatly. Now, wire up the switch and then insert it into the hole, replace the meter, tubes, and nameplate and you're all set.

Note here that the meter reading will be the *same* as before, even though you're only measuring the cathode current in one tube. Though the current has been halved (one tube current instead of two), the resistance (R408 and R409) has been effectively doubled, so the voltage being read by the meter remains the *same*. Therefore, when you're setting the idling current, for example, an *indication* on the meter of 50 mA is *actually* only 25 mA, but is nevertheless *correct* for the single tube. Throwing the switch in the other direction to read the other final's current should indicate the same thing once the bias has been adjusted. Really, you don't have to worry about halving the meter readings; read the meter as you normally would.

With a dummy load hooked up, switch to read V4 current. Adjust the bias control for V4 to indicate 50 mA. Switch to read V5 and adjust bias similarly. Now, depress the PTT switch on the mike and insert carrier with the CAR. BAL. control until the meter reads 150 mA as before the modification. Throw the switch back to V4 and check the current there. It should be

within 10%. Load, null the carrier, and modulate, keeping the meter at 150 to 200 mA on intermittent peaks in accordance with the instruction manual. As you can see, the operation remains the same. The meter is showing 150 to 200 mA on the peaks, but actually since only one tube current is being measured, the current is 75 to 100 mA. The nice thing about this is, you can tell if one of the tubes has pooped out simply by throwing the switch. You won't have to worry about one bottle doing all the work while the other loafs along, the working tube gradually taking on the appearance of a large maraschino cherry.

AVC Control

How about an avc on/off switch? Very easy to do. Just install a single-pole switch with one end connected to ground and the other to pin 6 of V11, the agc amp/detector. Here, the switch is a push-pull type which is part of the rf gain control. The original rf gain control was removed from the rig and a 10 kΩ pot with the switch section installed originally to be used with a 100 kHz calibrator. The calibrator did not satisfy me as far as long-term stability was concerned and was removed. The switch was then put to use as the avc on/off switch. It might well be used for some other purpose.

Break-In CW

There is yet another modification which I have installed in my unit which came directly from the Swan folks. This particular one is the "break-in CW" modification. This can be obtained directly from Swan and I will not go into the detail of it here. One thing I will mention, however, as pointed out in the factory mod sheet, is the fact that the VX-2 VOX unit is used directly when this change is installed, but the VX-1 unit can very easily be updated to the VX-2 unit simply by adding a wire from the 2N1302 transistor (Q5) to pin 5 of the VOX unit plug.

Possibly some of you have been troubled with the VOX unit triggering from the speaker "pop" on relay dropout. This would be more prevalent if the mike were not unidirectional. If you have made the modification removing the i-f's from the rf gain control line, terminals 3, 7, and 11 of relay K1 are actually freed from duty. These points could be used to switch the normally grounded side of the speaker output transformer. I have not tried it, so cannot vouch for its effectiveness. What I did, though, was to modify K2. Unfortunately, when K2 was manufactured on this series 350, the unused points were not supplied and there are simply slots in the insulating material where they normally

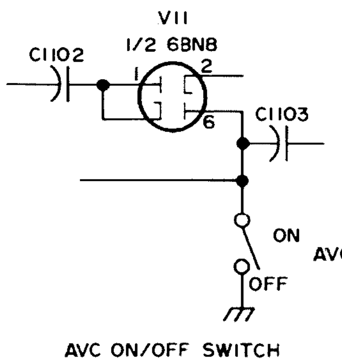

Fig. 7. A simple way of adding an avc on/off switch to the 350 or later models.

would be. So, I cut a point from an old relay I had lying in the junkbox and tapered the tail of it (the end away from the point contact) to fit snugly in the slot in the insulating material. This was done with a file, a bit at a time. It was then put into the slot from the armature end, leaving enough tail protruding on the far side to fasten a wire and solder to it. The homebrew point was secured with a glob of epoxy. Now, no "pop" is heard from the speaker on relay dropout.

Another quick change. A 25 μF 25V electrolytic from the mike jack tip connection to ground helps dull the "pop" on pickup. That was stolen from the Swan 500 schematic.

That's about it. It seems that it took a heck of a lot less time to do all these modifications than to write them up! Hopefully, it may help some of you fellas who have owned a 350 for a while and some who may have picked them up or are planning to, on the used market.

. . . K1KXA ■

Heath's Transverter

The Heathkit SB-500 2-meter transverter, when used in conjunction with the Heathkit SB-101, SB-110A, and HW-100 transceivers, or the SB-301/SB-401 receiver/transmitter combination, gives the user 2 meter SSB and CW transceive capability in any 2 MHz portion of the band.

In the receive mode, the SB-500 takes the incoming 2 meter signal and heterodynes it to either the 6 or 10 meter band, where the receiver processes it in the usual manner. Receiver sensitivity is 0.2 μV for a 10 dB S+N/N ratio.

On transmit, a driving voltage in either the 50 MHz or 28 MHz range is heterodyned to 2 meters, amplified, and coupled to the output. The "500" derives final plate voltage from the driver, but all other operating voltages are supplied from a built-in source, eliminating the need for an external power supply. Dc power input to the final is 130W PEP, with 50W output into a 50Ω nonreactive load. The "500" uses a pair of inexpensive 6146s in a push-pull AB1 configuration. A front panel on/off switch puts the SB-500 into operation or allows the driving unit to operate straight through to a linear amplifier or antenna. Relays controlled by the driver automatically switch the "500" between transmit and receive. ALC voltage is supplied to the driver to aid in preventing overdriving and distorted signals. Tuning is simple and fast, and a built-in front panel meter monitors either final plate current or relative power. The meter switch also controls the built-in 1 MHz crystal calibrator. After installation, there are no antennas or connecting cables to change back and forth . . . the on/off switch of the "500" does it all through a combination of complete relay switching and rear apron connections.

For further information on the SB-500, write the Heath Company, Benton Harbor, Michigan 49022.

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Puerto Rico	21	14	7	7	7	7	7	14A	21	21	21	21
South Africa	14	14	7	7	7B	7B	7B	14	21	21	21	21
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East Coast	21	14	7	7	7	7	7	14	21	21	21A	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.


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STAFF

Cover: "Chuck" Webb KØBWR gets the credit for this month's cover shot of Debby Hebert.

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Amateur Radio

NOVEMBER MCMLXXI Monthly Ham

BLAST ROCKS

On Sunday evening, July 25, 1971, fear suddenly became a major part of the emotions of a large sector of Birmingham area people. What had been a warm, quiet and peaceful time became alive with fear as an enormous blast shook houses over some 20 square miles or more. People ran from their homes and businesses to try to see what had happened. Moments later a second and much more powerful explosion took place, sending glass fragments from windows across rooms over a wide area, with enough force to embed them in opposite walls. Walls were cleared of wallboard, and garage doors were blown out. Power was off in a large area of eastern Birmingham and surrounding communities

A routine day's activity on the 2 meter repeater of the Birmingham Amateur Radio Emergency Service was suddenly transformed into a terse emergency net. Several stations were in the shock area, both fixed and mobile. The BARES alerting system activated when W4AXL received several calls. He notified W4WLF, whose family then called the rest of the list and the Red Cross Disaster Service. (The BARES is the emergency wing of BARC, the Birmingham Amateur Radio Club. The Red Cross is our host for meetings and provides space in the communications center for the Club Station W4CUE.) On the way to the Club Station, mobile units of the BARES were directed to proceed to Civil Defense, Red Cross, the disaster area, and other key points. Some stations were on as soon as the blast occurred, and by 2130, only 15 minutes after the first blast, a sizable group of stations was on and in position.

Within a few minutes reports started to come in by police radio that either a plane had crashed or a train had blown up at the rail yards. K4REL, still somewhat shaken by the blasts, reported he could see the fire. By taking side roads he was in the major damage area by the time most of us could get to our cars. He reported many homes in the Observatory Hill area suffered major damage. WB4JOY was on fixed, and he logged all stations as to their location so the data could be transferred to the club station disaster charts as soon as it could be manned. W4DFE and K4DSO were requested to report to W4CUE to assist there. By 2150 W4CUE was in contact with the Red Cross field units moving into the area, with Civil Defense, the Birmingham Police and Fire Departments, as well as many other agencies. The Jefferson County Sheriff's Department had charge of the overall operation since it involved several communities. They also were in the C.D. Net. Only a few minutes after the first blast K4TQR reached the explosion area and reported that the source of the disaster was an ammonium nitrate plant near the Norris Rail Yard (shades of Texas City . . . and who can forget that disaster?). W4DGY, also mobile in the area, reported that large traffic jams were already blocking many roads. Police roadblocks increased the confusion. K4TQR W4RTI and W4FKG assisted officers as requested, including manning roadblocks.

By this time mass evacuation of the area, including a heavily populated section to the north, was ordered by officials. They felt that due to the number of fires burning in the area and the belief – later confirmed – that more explosives remained, this was the only safe action to take. K4TQR and K4REL assisted in manning roadblocks and in a house-to-house search for injured. They also gave many residents the information to leave.

W4AYK reported to the main medical complex for duty. When it became clear they were not receiving large numbers of casualities, if indeed any, he reported on the air and left for the Birmingham Police Department control site. There he stood by for communications duty and rendered first aid to those needing it. Red Cross mobile units and canteens served coffee to workers and established a field command post where ambulances reported for standby duty.

K4OZQ, Director of Emergency Communications for BARC and head of BARES, reported to W4CUE and was in overall charge of the BARES.

Eddy Shell W5ZBC, a commercial photographer, snapped this picture of Rick Jordan racing at Shreveport. We wish Rick well. Have any other readers run across the number 73 anywhere interesting?

In the confusion at City Hall much-needed BARES operators were turned away and sent to the East Lake precinct to stand by. A later check with Civil Defense revealed that they did need help, so WB4MKU and Dr. William Hammack, a member of the club's Novice class were dispatched. One BARES unit stood by at a major shopping center until police could take charge to prevent looting. Almost every window in the center was blown out.

It has been reported that K4TQR did willfully violate his Southern upbringing when he assisted Revenooers (Alcohol, Tobaccö, and Firearms Division Agents of the Treasury Department) to find the blast site.

So far only a few calls have been mentioned. There were many units on, and many others available if needed. Only a few stations were placed in the disaster area, due to the possibility of another explosion. Those that were there, were able to do the required job.

News Pages

News of the World — 73 MAGAZINE

BIRMINGHAM

IN PACIFIC NORTHWEST

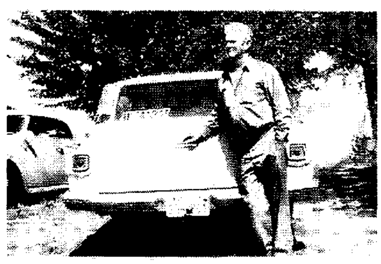
NAMSERVICE GOES BIG

(Special to 73 Magazine)

Out in the Pacific Northwest the new NAMService (Northwest Amateur Monitoring Service) on 3970 kHz has – in less than two months' operation – firmly established itself and already has demonstrated its emergency-rescue value.

In one of these K7EHN was up in rugged mountain area out of Vancouver, Washington, on a fishing trip. Backing his trailer to park it, one of the brake cylinders of his 1967 4-wheel drive International pick-up gave out. All four wheel brakes were then inoperative; he was "grounded" instantly.

Vic (K7EHN) got on 3970 kHz and was almost immediately talking (via phone patch) to his wife. She followed directions: drove to a Portland, Oregon, parts store for a replacement cylinder; got Vic's tools together and sent all this up to Vic with their nephew that same day. Next morning Vic (who is a master mechanic) removed a wheel, made repairs, replaced the wheel and was ready to "roll" again.



"Without NAMS I would have had to hitch-hike down the mountain and find a telephone somewhere, or even go clear back home," he said. "And with things as they are, some thief might have plundered my trailer and pick-up truck while I was gone."

K7EHN (he gets around, being retired from the merchant marine) on another occasion was hailed by a vacationing couple from California when he was at Lewis & Clark State Park – and they were in distress. Their car heated up, boiled over stalled, etc. Vic found dirty breaker

(continued on page 4)

This operation was an impressive operation on the part of the amateurs of the area. The many drills and operations to back community events showed its impact in the way the team reacted to the emergency. It was a well-organized effort and resulted in many comments from officials. The Red Cross Disaster Chairman had only praise for the work of the amateurs.

Except for one or two stations on 75, who relayed data from 2, all work was done on 2 FM through WB4QEX. This station is located on Shades Mountain, and is the BARES repeater on 34–94.

The caution of holding the units clear was proved to be justified, as not one job was assigned to our group that was not promptly handled . . . and two large magazines of explosives were found undetonated as cleanup crews started work at the plant site.

Damage to homes and businesses in the area is estimated to exceed $500,000. Fifteen people were injured and treated at hospitals, while numerous others received lesser cuts and bruises. None treated at hospitals were seriously injured. The force of the explosion left a crater 35 ft deep and 65 ft across . . . a stern reminder of what 20 tons of explosive can do.

Calls of stations known to have participated: K4YDI K4REL, K4TQR, W4RMB, WB4FGV, WB4JOY, W4YYH, WB4MKU, W4AYK W4RTI, WA4OBQ, WA4AWS, WA4OSB, W4HMV W4HMV W4AXL, W4WLF, K4OZQ, K4TWJ, W4FKG, WA4VUG, K4HAL, K4ZCY, W4WJX, WB4QES (Repeater), K4VRQ, W4DFE, K4DSO, K4AQZ, W4DGY, K4UMD, WB4JFG, W4CUE, and W4BJG. We hope we did not leave anyone out.

GEOALERT Now in English

GEOALERT, the world-wide solar and geophysical warning and information system designed to aid solar-geophysical researchers, as well as technological activities such as radio communication and long-line electric power transmission, has been modified so that its radio broadcasts are now in English-language voice rather than Morse code.

GEOALERT provides reports and forecasts of solar and terrestrial conditions and activity. This information permits observers and experimenters to coordinate and interpret their own observations with greater certainty and to calibrate their apparatus to better observe the phenomena which interest them. Technological activities monitor the GEOALERT broadcasts to help regulate and coordinate their work.

Current geophysical information and alerts are broadcast by WWV, Fort Collins, Colorado, and WWVH, Kauai, Hawaii, during the 18th minute of each hour from WWV and during the 45th minute of each hour from WWVH. The messages are updated daily at 0400Z with provisions to modify at any time to provide immediate alerts of outstanding occurring events. These are followed by summary information on selected solar and geophysical events during the past day and corresponding forecasts for the current day, all of which are prepared by the Space Environment Services Center.

The summary information includes two solar terrestrial factors of the past 24 hours, the solar flux (amount of energy radiated from the sun at a frequency of 2800 MHz) and the A-Index (an approximate measure of geomagentic storm activity.) Other solar terrestrial conditions reported when they occur are the degree of solar activity, the condition of the geomagnetic field, the coordinates and time of major solar and proton flares,

(continued on page 4)

(cont. from page 3, col. 2)

NAMSERVICE

points needing replacement; he cleaned them and got the car running. But he also broke into NAMService and (via phone patch) reached the couple's relatives in Yakima. They promptly motored down to make sure all would go well.

"Those people were due to catch a plane at Seattle in a short time," Vic explained, "and if it hadn't been for NAMS they would have missed it."

Alerting the state patrols for wrecks on freeways is more or less regular in NAMS operation. One afternoon a camper body fell off a pick-up truck north of Tacoma, Washington, on Interstate 5. WA7GYP/mobile 7 saw it happen; he was monitoring NAMS and immediately reported it to monitor control (WA7BKR at that time). W7UU, likewise "guarding" 3970 kHz while at work, heard the exchange and broke in; then telephoned the Washington State Patrol. Within minutes a state patrol car was on the scene. WA7GYP doubled back as soon as he could; when he arrived back at the scene the state patrol car was there.

A similar incident occurred when WA7VPW/mobile 7 chanced to be crossing the Interstate 5 bridge over the Columbia River at Vancouver, Washington when, ahead of him, a car and a Greyhound freight truck tangled. Ken (WA7VPW) broke into NAMS and a state patrol car was on the scene within minutes.

That same day W6MRA/mobile 7 on Interstate 5 near Eugene, Oregon, came upon a car on fire in the median strip of Interstate 5. Calling NAMService immediately, he reported the accident and the Oregon State Patrol was alerted and got to the scene quickly.

Sometimes it's just a matter of helping someone – as when K7MHL/mobile 7 was crossing White Pass near Yakima, Washington, and saw two pretty girls with a disabled Volkswagen. Stopping, he ascertained it had run out of oil; its engine was ruined. Via 3970 kHz and W7UU in Seattle, Bruce (K7MHL) gave all the details to the Seattle office of AAA and a tow truck was on its way.

NAMS is a completely voluntary "unorganization" and perhaps that is why it has caught on so quickly and well. It has no officers, no membership list, no roll call, no dues.

"It's all Indians and no chiefs," explained Curly Milner (W7MDM), of Sara, Washington (near Vancouver), who started it out on 15 July 1971. "We want to keep it that way. Hams know how to operate NAMS the minute they hear it. Regimentation and coercion are what we don't need."

NAMS serves Oregon, Washington, Idaho and British Columbia (Canada) – and sometimes farther, when conditions permit. It runs from 9 a.m. until 5:45 p.m. daily, and seldom is there lack of a monitor control station – someone to speak up every half-minute or so and provide a "hitching post." If 3970 kHz is silent for a few moments, someone is sure to notice it and start calling for a monitor control.

And so you hear, more than anything else in the Pacific Northwest these days, the statement "This is ———, monitor control for NAMS, standing by on 3970 for breaks."

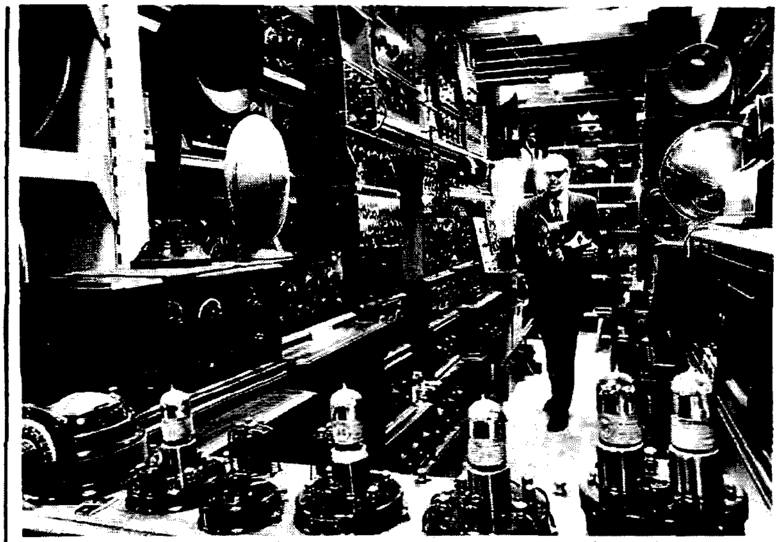


Photo: Courtesy Daily Courier News, Elgin, Illinois.

ANTIQUE RADIO COLLECTION

Dr. Ralph W. Muchow of Elgin, Illinois has one of the largest collections of old radios in the world. These are all built from 1900–1927, when batteries were replaced by ac supplies, and all of these old sets are in good working order! If you are interested in old radios you might get in touch with Bruce Kelley W2ICE, the Secretary of the Antique Wireless Association, Holcomb, NY 14469 and ask about membership and a subscription to their very interesting and well done magazine. If you are visiting in the vicinity of Holcomb you might want to see the club museum which has over 600 old radios!

(cont. from page 3, col. 3)

GEOALERT

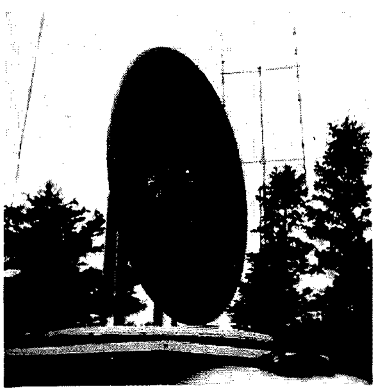
the occurrence of flare-related proton events observed on satellites and polar cap absorption events.

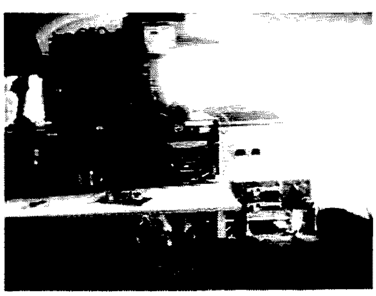
The forecast for the next 24 hours includes the degree of solar activity, the condition of the geomagnetic field, the time of an expected geomagnetic storm, and the coordinates for an expected proton flare. A stratwarn alert, provided by the National Weather Service, reports expected stratospheric warnings in the high latitude regions of the winter hemisphere of the earth.

ARRL BULLETIN

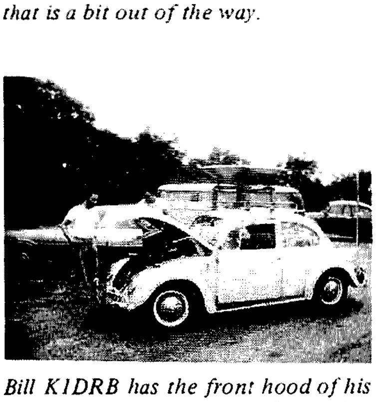
WWV transmits time signals by voice every minute on 2.5, 5, 10, 15, 20 and 25 MHz. WWVH in Hawaii uses 5, 10 and 15 MHz and may be identified by the use of female voice announcements. Every 5 minutes propagation notices applying to paths over the North Atlantic are sent by WWV in code, using a letter and number. North Pacific forecasts occur from WWVH. The letter N indicates normal, U unsettled and W disturbed. The numerical scale is the forecast for the following six hours and ranges from number one, or useless, to number nine, excellent. CHU, the Canadian time signal station, transmits on 3333, 7335, and 14,670 kHz with voice announcements each minute in both English and French. The ARRL Handbook carries full information on these services. The publication detailing Standard Frequencies and Time Services is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

SEPT. VHF CONTEST



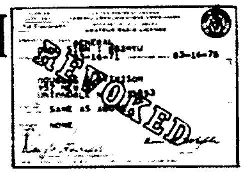


Yup, that's a six foot dish on top of that VW bus. This was a summer project by Bruce WA1LXU and was the heart of the 1296–3300 MHz effort of the Honeywell 1200 Radio Club W1DC operating in the September VHF contest from the top of the Pack in Peterborough. Inside the bus Hank W1OOP had his usual line of gear for 220, 432, and up. The extra multipliers on 1296 and 3300 MHz made W1DC a tough customer to beat in these contests in spite of a location that is a bit out of the way.



Bill K1DRB has the front hood of his VW open again, as on the September cover picture. This time he's off to operate elsewhere during the contest. Bob K9AQP/1 looks on from the left.

WITH THE FCC



Things have been relatively quiet on the FCC front, with the notices being strictly routine . . . at least routine for most of us. The few amateurs mentioned in the FCC releases were involved with citations, fines, and the like. For instance K7ABV paid a $50 fine, WB4DXX has had his license revoked, WA6GMR is threatened with revocation, as are the licenses of K2WSP and WN4RGR.

PETITIONS AWAITING FCC ACTION

Thanks to Bob Chapman W1QV for this interesting list of petitions on file with the FCC. Copies of the actual petitions may be had at a nominal charge from Cooper-Trent, 1130 19th Street NW Washington DC 20036. Watch out, though, for some of these petitions can be very, very long and thusly a lot more expensive than you might expect. Ask first.

RM No.	Date Filed	By	Substance
968	3/66	San Diego County	Use of other than 220 MHz to remotely controlled RACES Stations.
(1016?)	8/66	?	Tech operate on Novice HF band with CW.
1116	3/67	California CD	RACES Rules, control of non-ham licensees.
1346	8/68	K3MGO/K3MNI	Senior Citizens License.
1363	10/68	K2ZRO	"Advanced" Tech License.
1429	3/69	WA8DCE	Permit F-4 at 144 MHz.
1454	5/69	K1KTB	Allow Techs to use CW 80 through 10.
1455	5/69	W2NSD	Counterpart call signs.
1456	5/69	W2NSD	Permit Techs same CW priv. as Novices.
1478	4/69	W6PQH	Permit 40F2 emission by RACES on 2 & 1¼.
1516	10/69	WA6FNR	Tech privileges 21 MHZ Novice band.
1520	9/69	W3KMV	CW & phone segs, 6m Advanced band.
1521	10/69	K1RKL	Tech CW privileges.
1526	10/69	W3BWU	Tech CW privileges, 10m.
1535	11/69	ARRL	Tech priv., 29.5–29.7 & 144–148 MHz; dual holding, Novice & Tech.
1536	11/69	ARRL	Counterpart call signs.
1542	12/69	K6MVH	New repeater rules.
1568	2/70	W8WEF	Novice priv. for Techs.
1572	2/70	?	New license "Tech First Class."
1597	4/70	ARRL	1 x 3 call signs for new Extras.
1602	4/70	WB4OBZ	Novice priv. for Techs.
1604	4/70	WB6UTC/WB4NQA	Change ID rules for short QSOs.
1615	3/70	W5JJ	Cond. Class limited to 1 yr; no new Tech; create Intermediate & Communicator licenses.
1629	5/70	W7ELN	Create military examining point in Germany for FCC amateur exams.
1633	5/70	W2NSD/1	Create Hobby Class lic. 220.5–224.5 MHz.
1646	4/70	WA3JHB	In part: 1 x 3 calls for Extra Class lic.
1655	3/70	W3BQN	Substitute holding of commercial lic. for part of 25 yr stint for 2-letter calls.
1656	6/70	W6ODX	Set minimum age for ham license; move CB to 220 MHz ham band.
1658	7/70	Williams, Paul	Move Extra Class Grandfather clause up to 12/1941.
1677	8/70	WA2GGX	Provide 1 x 3 calls for new Extra Class; see RM-1597.
1703	10/70	K3UEJ	Call letters of SK to a family member.
1711	11/70	W1FK/W1KVP	No d.s.b. below 32 MHz.
1724	12/70	WA2LRO	Reduce General code to 10 wpm; give Techs Novice CW privs; restore Novice A-3 in 145 MHz.
1725	12/70	K6MVH/1	Drop licensee control & monitor for repeater with auto. turn-off & coded access.
1747	2/71	EIA	CB on 220–222 MHz.
1748	2/71	WA6GLD	Expand voice bands.
1761	2/71	K4ETZ	Hobby/Personal Radio service on 220 MHz.
1771	3/71	W3EWI	Require certificate of performance, etc. on equipment commercially produced or imported for the ham service.
1776	5/71	WB2EZG	Establish a new ham license above Extra Class.
1787	5/71	Bracy, E.L.	Move Extra "Grandfather" clause to 1/1/40.
1793	5/71	W2GHK & W3ASK	Establish VHF radiotelephone license in ham service.
1804	5/71	K2UTC	25 KHz standard AM 80–15m, 250 w. max. (No SSB in these segments.)
1805	5/71	W7NVY	2 new code-only licenses.
1811	6/71	W8WZ	Grandfather clause for Extra – 50 years.
1830	6/71	K8QEW	Change name of Amateur license to Radioman.
1841	7/71	United CB's	Turn 27 MHz over to "hobbiest," all personal and business CB work on 220 MHz.
1843	7/71	W8JJL	Automatic Extra Class lic. after 25 yrs service (general or higher).

EDITORIAL BY WAYNE GREEN

Staff Openings

We have openings in the advertising, editorial and circulation departments for qualified amateurs who might be interested in combining their hobby with their work.

In advertising we need someone to help contact prospective advertisers and convince them that 73 is the best possible medium for bringing their gear to the attention of the active amateurs. We feel that whenever we are unable to convince an advertiser to use 73 that we have failed not only ourselves, but the advertiser. When we see his ads in other magazines we feel that we have let him waste his precious ad money and we feel miserable that we have let him make this terrible mistake. Sure, we realize that not all readers of Brand X are mentally underprivileged, even though the magazine seems to be written primarily for this audience, nor are all the readers of Brand Y the "build-don't-buy" fanatics that the magazine seems to cater to, but we wonder if exceptions are enough for us not to feel guilty when, through our ineptitude, an advertiser virtually throws away his ad budget by supporting these magazines.

Some background in selling or advertising would be most helpful for this position, since we have to act as advertising agency to roughly half of our advertisers. It is difficult to lay out an ad for a client, write the copy and even arrange for photographs and artwork without some experience in this field.

In the editorial department we need an experienced amateur to help test new equipment and write it up. We need help with preparing the newspages, with the editing and preparing articles. Writing experience would be valuable for this position, as would background on the air working DX, RTTY, contests, VHF, FM, and other facets of the hobby. Solid state know-how will be invaluable too.

In circulation we need a knowledgeable amateur to help us reach potential subscribers and convince them to get 73. This means letters to newly licensed amateurs, to radio clubs, booths at conventions, etc. It is an interesting and fascinating job and it calls for a dedicated amateur with some experience in direct mail work, writing, and a lot of drive.

73 is an interesting and unusual place to work. It is utterly informal, from the offices strung out through an old New England mansion to the croquet games at lunch and after work. In the winter we take time off for skiing, when the snow is right. The area is fantastic for anyone who digs hiking, easy mountain climbing, trail biking, lakes, scenery, clean air and water, camping, skiing, snowmobiling, peace and quiet, the country life far away from the hassle of the city, the most beautiful fall coloring in the world, and a climate that doesn't get too hot in the summer or too cold in the winter. Many of our employees live in seclusion at the end of long dirt roads, surrounded by woods.

Permanence? Nothing in life is permanent except change, but things certainly look bright for us. In a field where virtually every publisher is awash in red ink, with one cutting ad prices to anything he can get just to keep his pages filled, we are comfortably in the black and working on expansion rather than drying up and blowing away.

If you think you can handle one of these jobs, send along a resume' and let's see what happens. The pay? Enough, but not a lot . . . probably less than you're getting now. But pay isn't everything, right? If money is all that important to you, you'd do well to stay out of amateur radio entirely as a business and particularly out of amateur radio publishing.

Technician Proposal

There has been a proposal filed with the FCC for several years now asking that Techs be permitted to use the entire 144–148 MHz two meter band. I am 97% in favor of this and would like to see it come about. One of the possible hangups is that this would open the 144.0–144.1 CW band to Techs. I see nothing much wrong with this . . . I know several Techs who are a lot better at CW than I am . . . and a little CW practice won't hurt the rest of them . . . but this may be a block from the FCC's viewpoint. Perhaps someone would be so nice as to send a petition to the FCC requesting that the Tech band be expanded to 148 MHz, but leave the 144–145 segment for higher class licenses. Perhaps this compromise would get some action. With repeaters filling up the 146–147 segment of the band it is getting late in the game to plan the next step . . . will it be repeater expansion into the 145.5–146.0 part of the band or on up above 147?

Relay Repeaters

Clubs with repeaters that are looking for some additional action might think in terms of setting up a relay repeater. Though the FCC has threatened to prohibit this, they haven't as yet, and the more that we have going successfully the better argument we have to keep them going. If we don't set them up now before they are prohibited we may never get the chance.

For instance, a 91 or 97 input repeater in New York City or Northern New Jersey, or even Eastern Pennsylvania, could repeat New England and Eastern New York repeaters down to Philadelphia. An output on one of the lesser used repeater channels down there would complete the trip. A 91–16 machine would relay WA1KFZ (soon to become K1FFK on Mt. Greylock) down to WA3BKO in Philadelphia, tying almost all of Massachusetts, half of Connecticut and most of Southern Vermont and New Hampshire into the Eastern Pennsylvania and Southern New Jersey regions.

Why the 30 kHz Spacing Between FM Channels?

Even with fairly slective receivers, 30 kHz is all too thin a line. For example, at the WA1KGO site on Pack Monadnock in Southern New Hampshire we are using a G.E. Prog line receiver. We find that stations that are a bit off the 34 channel, perhaps 10 kHz, sneak through on our 37 input on our receiver. This is frustrating, and it illustrates all too clearly that there is no way to sandwich any channels between the present 30 kHz accepted standard. As you narrow down the bandwidth of an FM signal you begin to lose the noise-rejecting benefits of the mode, so substantially narrower receivers do not seem practical.

Some work can be done on improving skirt selectivity of i-f strips in amateur receivers and I think we will have an article or two before long on a simple and inexpensive filter which will greatly help most receivers. I notice the difference between receivers when I operate from mountain tops. With broad receivers the signal from WA1KFZ 70 miles away on 91 comes smashing through on both 88 and 94 channels. The more selective receivers ignore the KFZ signal on adjacent channels.

Why 600 kHz Repeater Spacing

About 75% of the repeaters in the country are now set up on what has become the standard spacing between the input and output of 600 kHz – for instance take the most used pair of frequencies of 146.34 in and 146.94 MHz out.

The 600 kHz split was chosen because it was wide enough, just, to permit a repeater receiver to operate with its receiving antenna on the same tower as its transmitting antenna. Much less of a split and the problems of keeping the transmitter from triggering the receiver become formidable . . . and expensive.

Okay, so 600 is a minimum, but what difference does it make if the spread is more than that? There will be that much less trouble setting up the repeater if 800 kHz spread is used, so why isn't this even better?

It would be better if there were no other considerations. There *are* some other considerations that enter into the picture. One is that most FM operators want to be able to work simplex as well as through the repeater. Most of the amateur FM transceivers are delivered today with crystals in place for 34/94 and 94/94 as starters. It is asking a lot of a transmitter to expect it to be reasonably in tune for both 146.34 and 146.94 with only the switching of the crystal taking place. If the input were moved to 800 kHz or down to about 146.13, the output at 146.94 would definitely be down on many of the rigs.

This is a problem, but not really compelling enough to make anyone adamant about 600 kHz spacing. There is one more good argument that you, as a repeater owner or user, should mull over in your conscience and that is this. If your repeater is split more than 600 kHz, this means that the complimentary channels which would normally be used for 600 kHz are going to be split less than 600, and their use would be limited to repeaters with split sites where the spacing between the receiving and transmitting antenna can be made great enough to overcome the narrower split. Is this really fair? Few repeaters are in locations where the receiving site can be split from the transmitting so, in most cases, your use of more than 600 kHz renders another pair of frequencies unusable.

In areas where there are only a few repeaters this is not yet a problem. But in a growing number of areas virtually all channels between 146 and 147 are fully occupied and new repeaters either have to set up outside of the band or else trod upon toes of earlier repeaters, with subsequent wars.

Fellows, please do give serious thought to setting up new repeaters on 600 kHz spacing and to moving present repeaters to that standard. The move will reduce QRM a lot.

If any crystal manufacturer, equipment manufacturer, club or individual would be interested in setting up a crystal bank, I can guarantee that I will do whatever I can to make the project a success. I would like to see some group or company offer to buy used crystals for a reasonable price in order to make it reasonable for repeater users to change channels. At $5 to $10 a throw for crystals, it is difficult to get a lot of FMers go agree to change repeater channels. But if they knew that they could change crystals for a buck or two apiece, it might be a different story. Any takers? It wouldn't be a big deal to set up in business . . . about 1000 crystals would get it going.

RTTY Repeaters

Dunno if many of you remember, but the very first two meter repeaters were set up for RTTY. Back in 1948 John Williams W2BFD set up a repeater on top of the Municipal Building in New York which repeated the AFSK RTTY signals on 146.96 MHz, enabling all of the TT fellows in Greater New York to get in touch with each other. Most of us were using SCR-522s in those days and they were fine for the job with their wide 12 MHz i-f.

Today there are a growing number of repeaters being set up for RTTY. Most of them have been established on the 10–70 channels and it seems reasonable to me for us all to think in terms of holding out that pair for RTTY across the country.

Repeater groups might give serious consideration to setting up an RTTY repeater in addition to their FM unit. Once an installation has been made it isn't all that difficult to add a second repeater. If all goes well at the WA1KGO repeater here in Peterborough, we'll add one of the Dycomm Echo II repeaters for 10–70.

TTers can plug their AFSK oscillators into their two meter FM rigs and operate through the local 10–70 repeater. There's nothing much to it.

Gregory Electronics

The ham sales of FM gear are secondary to the turnover of equipment for the commercial users, I was told as I toured the impressive warehouse full of surplus FM equipment at the Gregory Electronics plant in Saddle Brook, New Jersey. They have mountains of both mobile and base units there, low and high band, plus a staff to check them out and make sure that they are in good shape before shipment.

Dave Pearlstone, president of Gregory, welcomes us to the plant.

If you are interested in FM it will be worth your while to visit Gregory and pick out an extra rig or two. They are just about 15 minutes from New York City, right on Route 46.

Just a small part of the piles upon piles of FM rigs. Incredible!

Repeater Updating

In order to make our repeater listings valuable we do need to know what repeaters are on what channels where. Please assume when you find an error in our past listings that no one has corrected us and take it upon yourself to drop a card with the info. We would like to publish charts of the repeaters in use for each major population center, so would you take the time to make a list of the repeaters within range and send it in? Please give the repeater call, its location (town, mountain, or whatever will locate it in one word), and its frequencies.

Our Man-in-Washington

Washington lobbyists have their hands full these days. They must keep in touch with all three branches of the government: legislative, executive and civil service. They have to be available to provide information wherever it is needed and this is not a simple job. First of all they have to know the answers to questions or at least how to get them quickly. Then they have to know who might need the information and be sure that it is there at the right time.

Perhaps the most important function of the representative is to find out what is happening on all three levels of government and make sure

(continued on page 9)

LETTERS

PEN PALS?

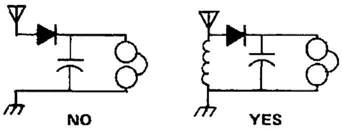
I hope you will forgive me for writing to you. I'm a Soviet ham of seventeen years of age. I've been looking for a ham in a foreign country with whom I may correspond, and you can't imagine how happy I should be if you would enable me to realize my cherished dream.

Well, I am going to tell you a little about myself. My name is Victor. I have finished Secondary school this year. My hobbies are ham radio, pop music, and so on. I want to correspond with any boy, from any State. I have a friend who is also a ham and also wants a pen pal from the USA.

I'm afraid you can't read my English easily because I'm not very good at it. But I hope you can understand it, anyway.

Victor Taran
Post Box II/I
Kiev – 139
252139
U.S.S.R.

CORRECTION



By now I suppose your office has been inundated with protests by hundreds of disgruntled Novices. I am referring, of course, to Part X of the General Class License Study Guide in the July issue. The "simplest radio receiver" shown in Figure 1 cannot possibly work – since a diode must have a dc return path in order to rectify ac. I suggest you add an rf choke from the antenna to ground.

75 years since Marconi, and some people still get it wrong! Tsk! Tsk!

Donald Kochen K3SVC
Dundalk MD

NON-RENEWER PENITENT

I was working very nicely toward DXCC with 82 countries worked. I also had 45 States confirmed for WAS. Not bad for a Novice, right? My first hint of trouble was the 15 meter band going to the dogs. Then I ran into all kinds of trouble getting a 40 meter vertical up in my yard. Finally, the very night I had a sked with DL4BW to check out the 40 meter vertical, my receiver died. Please, please, renew my subscription before the gods become angrier.

James J. Lord WN2OSI

Okay, but watch it next time.

GAP?

Thought you might like to know that there is no generation gap in ham radio. Just a communication gap between the ARRL and the amateurs themselves. Keep up the good work but please, a little less FM and more Bob Manning (K1YSD) – enjoy his madness – and more YL candid shots.

Bob Damrau WA1LOT
Clinton CT

JANEL 432CA CONVERTER

After searching around for the ultimate 432 converter for the past three years and using the leading 432 transistor converters, I decided that my own home brew style nuvistor converter with a transistorized preamp was indisputably the best. To make a long story short, I soon discovered that my home brew converter wasn't the best and my egotistical nature decreased to minus 80 dB. The Janel converter did an excellent job with plenty of gain and low noise level, which gives it a big plus for the serious 432 enthusiast.

The circuit uses 5 NPN bipolar silicon transistors, one MOSFET, one zener diode for local oscillator voltage regulation, and two diodes in a full-wave built-in ac power supply. The rf amplifier uses a 40235 in a common emitter configuration, with a broadband input circuit to tune out input reactance, insuring a low noise figure, and two silver plated strip-line output circuits for maximum selectivity and image rejection. The local oscillator chain begins with a crystal in the 100 MHz region, thus reducing the number of multipliers and spurious responses. A 40235 oscillator excites two 40235 doublers to obtain oscillator injection frequency which is mutually coupled into the base of the 40235 grounded emitter mixer. The output of the mixer is capacitively coupled to the 3N140 dual gate MOSFET stagger-tuned i-f amplifier providing 0–27 dB of i-f gain with the adjustment on the front panel.

All American components are used, which are mounted on an epoxy PC board and housed in a metallic green two-piece die-cast aluminum cabinet. Each converter is tuned to order and individually built and tested. Other features of this converter include a jack for 12V dc input and its relatively small size (6 3/4"L, 5 1/2"D, 2 1/4"H). Other specifications are as follows:

Frequency input: Any 4 MHz segment between 420–470 MHz; Stocked fre-

(continued on page 10)

DX FOOTNOTES

ZL4OL/A Campbell Island on around 0930z 14026, and 0300z on SSB on low end of band. QSL ZL2GX. ZL3OL/C Chatham Island on at odd hours on CW on 3510, 7010, 14030, 21030 and SSB 3690, 3790, 7090, 14190, 14625 (Pacnet), 21300. QSL to ZL2AFZ.

SPRATLY ISLAND

DU1DB, who was hoping to make the Spratly DXpedition from VS6 and W, did not get his boat in shape in time to have the expedition completed by the time the typhoon season began, so the DXpedition has been put off indefinitely. Anyhow, the islands are now the focal point of a political dispute. BV-Land has occupied one of the Spratly group and DU-Land has lodged a protest. Meanwhile the BY boys have constructed a military base on the nearby Paracel Islands. Both of these island groups are also claimed by both halves of XV-Land. So the chances of there ever being a DXpedition to these areas is remote indeed, unless a member of the Chinese Signal Corps decides to try ham radio. *(Info tnx to Gus.)*

BHUTAN. AC5PN continued to show up rather regularly in the last part of August, the West Coast getting in there frequently and often Yonten being worked in other parts of the country. One report says he was on every morning from 1300kc between 14034–14036kc. ITU told him that Bhutan can officially request an ITU prefix and then make their own internal assignements for amateur, commercial, government and military calls. Yonten is still using the call AC5PN but may change it to AC5PY . . . or he may wait for the ITU action. There is a report that a beam antenna is being offered. Possible that no QSLs will be printed until call sign clarified. Pre-prepared QSLs may be successful.

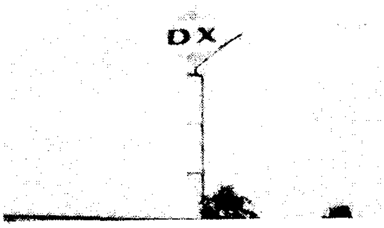
SIKKIM AC3PT showed up recently around 14300kc from 1300z. No set frequency but this is the area . . . sometimes higher, sometimes earlier. Has also appeared on SEANET. One day UA1CK was emceeing the action.

CAMBODIA 9M2IR visited in Cambodia and obtained operating permit – VE7IR/XU. Plans are to demonstrate amateur radio to XU-officials and then push for lifting of ban.

BURMA 9M2IR also visiting in Burma. Telecoms Director there says 12 XZ-licenses still in effect but high-

er authorities banning transmitting. Apparently no foreigner will be allowed any XZ-operations and a Burma citizen probably will be the first back on the air . . . when things are eased. *(Thanks to West Coast DX Bulletin)*

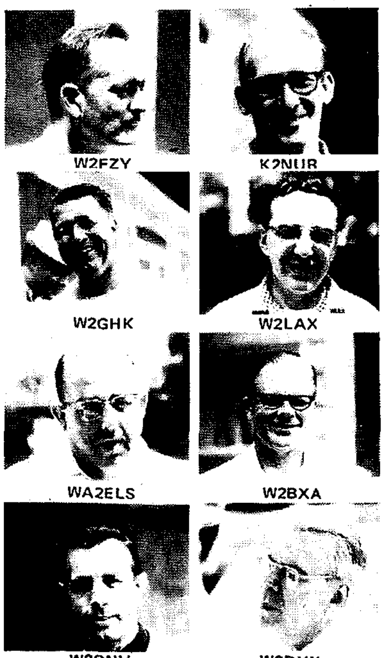
Look for W7UXP/KM6 Midway around 21–24 Oct., and /Kure Island from the 25th of Oct. QSL to KH5HCM, 5952 Gannet, Eva Beach HI 96706.



Leave it to dedicated DX chaser W4NJF to spot this one and snap it from the car window between Jackson and Nashville.

Some DXers from Two Land

If you have any reasonably good photographs of well-known DXers, send 'em on in. The following were snapped during a DX get together in New Jersey. If the band is open at all you will hear at least one of these chaps coming through.



DX MAILBAG

On November 3rd Wayne Warden, Jr. (W9IGW) and myself (W2BBK) plan to arrive at St. Maarten. We will be operating for a couple of days from the French side of the island as FG0GD/FS7. Thereafter we will go to Anguilla for a few days, operating as VP2EF (Wayne) and VP2ES (myself), in company with PJ7VL (Vince LaBega). After the Anguilla stint, I will be returning to Dutch St. Maarten for a few days to operate as PJ8AA. We plan to cover all bands that are open from 10 through 80, both phone and CW. We will generally be 30 kHz inside the low edge of each American CW and phone band.

QSL's from FG0GD/FS7 and FP2EF should go to W9IGW.

QSL's for VP2ES and PJ8AA should go to W2BBK.

"Doc" Evans W2BBK
Englewood, NJ

LOOKING AT SOME WELL KNOWN DX'ERS

W1OOP Hank, one of the vanguard on 220, 432 and up. You'll hear him operating from W2DC during contests if you ever want to contact New Hampshire on one of the UHF bands.

W2NSD/1 *cont. from page 7*

that the amateurs are aware of anything of importance to them. This means keeping close track of administrative programs legislative proposals and actions, and agency regulations. There is a virtual army of GS-10 employees in government agencies who work through the years, no matter what party is in power or which legislator is elected, and most of the things that seriously affect amateur radio happens on this obscure level – a level that only a professional lobbyist can really know.

The mere presence of such an individual is enough in many cases to insure that amateur radio will get a better deal. Actions on fairly low levels in the State Department, Army, Navy, Air Force, and many other government agencies can have long-range effects on us. Would the Voice of America have quite so many of their incredibly loud transmitters in our ham bands if we had any clout? It is just a small thing, to be sure, and of little import to FM'ers, but a lot of 40m ops may stop and think a bit about it. VHF operators might wish that there had been a loud voice asking questions when the Air Force decided to take first priority on all UHF bands a few years back, permitting amateurs to continue to use the bands as long as there was no interference to the AF. Hmmm? Those are just a couple of small examples.

. . .Wayne

AL	WA4AHX	Albertville	34–94
AL	WA4AHX	Albertville	20–76
AZ	WA7HUH	Globe (CD)	145.68–146.85
AZ	WA7AJU	Mingus Mt	34–94
AZ	WA7AJU	Mingus Mt	16–76
AK	?	Ft. Smith	34–94
AK	W5ZF	Hot Springs	28–88
CA	WB6DGJ	Eureka	34–94
CA	WA6URI	Inland Empire	16–88
CA	WA6URI	Inland Empire	145.48 146.88AM
CA	K6APE	Kern County	145.25–146.75
CA	K6MYK	Los Angeles	146.98 145.22AM
CA	K6ROC	Los Angeles	147.24 145.22AM
CA	WA6UPB	Los Angeles	145.175–147.66AM
CA	WA6ZOC	Los Angeles	224.82–221.74
CA	WA6ZOC	Los Angeles	224.82 146.40
CA	K6SYU	Orange County	52–19
CA	K6SYU	Orange County	145.62 146.19AM
CO	WA0VVC	Denver	444.35 449.35
CO	K0OVQ	Denver (1800T)	146.82–147.30
CO	WA0BAG	San Luis Valley	16 76
CT	WA1KHK (was WA1JNO)	Avon	28 88
CT	WA1KGB (was W1BNF)	Meriden	37–97
CT	K1IGF	New London	19 79
IA	K9ITW	Now defunct	
IL	WA9ORC	Chicago	16 76
IL	WA9ORC	Chicago	34 76
IL	WA9ADW (was W9BYZ/9)	Genoa	34 76
IN	WA9WVC	Anderson	22–82
IN	W9INX	Ft. Wayne	28 88
IN	W9INX	Ft. Wayne	52.64 52.88
MA	K1OAI	Oxford	22 82
MA	K1FFK (was WA1KFZ)	Greylock	04–91
ME	W1FFF	Gray	34 94
MI	K8WNJ	Muskegon	22 82
MI	Simplex	Muskegon monitored	94 94
MI	? (creating fury in Chicago)	Benton Harbor	34 94
MI	? (Murderous situation?)	Benton Harbor	94 76
NJ	WA2PRI	W. Orange	04–85
NJ	WA2UWP	Bergen	28 79
NJ	WA2ZVQ	Toms River	31–91
NJ	WA2UWO	(Woodbridge (PL)	22–82
NJ	.	Sayerville	16–76
NJ	WA2UWC	Greenbrook	34–94
NY	W2CVT	Mt. Beacon	37 97
OK	WA5SJE (was WA5KWH)	Tulsa	22 82
PA	WA3BKO	Philadelphia	16–76
PA	W3TKQ	Philadelphia	29.640–29.493
RI	W1HQV	Providence	22–82
WA	VE7APU delete from list		
WA	VE7MQ delete from list		

Thanks to WA2ROJ, WA8GVK, W2LAL, W1UPB, WA9CWE, W2AWX, W1WAS, and K9LSB.

LETTERS

(continued from page 8)

quency output: 26 30. 28–32, 50–54 MHz; Gain (front panel adjustable): 0 to 35 dB; Noise figure: 4.3–5.5 maximum dB; I-f rejection at 28 MHz i-f: 75 dB; Image rejection at 28 MHz i-f: 40 dB; Maximum input signal level: 10 mW; Power supply: 117V ac or 12V dc @ 40 mA; Price class: $65.00.

The manufacturer also has plans for producing an antenna mounted 432 MHz preamplifier with built-in antenna relay and power supply. The Janel model 432CA converter and further information are available direct from *Janel Laboratories, P.O. Box 112, Succasunna, N.J. 07836.*

Lyle T. Dysinger WA2VJC
Clifton NJ 07011

About a month ago I had the good fortune and pleasure to take a motor trip through Canada, and on my return visit I detoured through New Hampshire just so I could visit you and 73 Magazine. I am sorry that you were not there at the time but I enjoyed the visit anyhow. Your whole staff, including your charming wife and daughter, just dropped their chores for the moment and treated me like a long lost brother It almost made me envious to see the famous Southern Hospitality being outdone by all those Yam Dankees. In fact, everywhere I went in both New Hampshire and Vermont, people were so doggoned nice to me it just made me even prouder to be an American.

After I reluctantly left 73, I decided to drop by the ARRL headquarters, but they didn't seem to be quite as glad to see me. My reception wasn't cool, but it definitely lacked the sparkle of my visit in Peterborough. For facilities they have you beat hands down, having a well-stocked museum, operating building, spacious, richly appointed offices, well-equipped laboratories, plenty of technicians to work on construction projects, et cetera, but facilities alone cannot make up for other deficiencies. I wanted to meet some of the personalities whose names regularly appear in QST magazine, but they were too busy to see visitors. The best I could do was to subscribe to QST – maybe on my next trip (if ever the opportunity strikes again) they might be a little less stuffy about their own importance.

I think that you and your staff issue an outstanding magazine from every respect and am proud to be a life subscriber, but if it would help you to become a director of the ARRL I would not mind your selling out to someone who could and would maintain the top quality everyone has come to expect in every issue of 73. If I had the money it would be me – I like the country, I would eat up the challenge, and the general subject matter is of great interest to me. Right now, the best I can do is to recommend 73 to all my friends and non-friends alike.

If you are ever in Jackson, look me up – I am not famous nor do I publish magazines, but my steaks and hospitality are known far and wide. "Y'all come!"

John Salter
Jackson MS

Make mine thick and very, very rare . . . okay?

In your "New Books" column in your last issue, you had a small picture of a bookshelf and on it were books with humorous titles such as *Cold Solder Joints I Have Known*, and *Coax Cable Braid Weaving*. How could you forget such best sellers as *First Aid for Bleeder Resistors*, and *A.M. and AM Not???* Don't forget the sizzler from SM land, *My Study on the Skin Effect*. I feel your library is lacking without these books.

Karl G. Smrekar Jr. WN3PJB
Houston PA 15342

VHF Construction Lines!

This bit about "VHF home construction to be stopped?" in August 73 referring to the certification of radio receivers for use above 30 MHz sent me to my copy of Part 15. According to it, "no radio receiver . . . that operates in the range 30 to 890 Mc . . . shall be operated without a station license unless it has been certified . . . "

In Part 15 there is no reference to converters, so presumably it is not necessary to certify these, as they are certainly not receivers. In addition, receivers tuning below 30 MHz do not require certification. Put the two together, and what do you get? Obviously not a receiver, but a receiving system. Part 15 has nothing to say about receiving systems. The moral is – don't build VHF receivers. Keep converters and i-f systems in separate boxes and be content with receiving systems.

In the event that the legal experts construe "receiver" to include "receiving system," there is another way to legally avoid problems of certification of equipment. Part 15 states that "no radio receiver . . . shall be operated without a station license . . . " – so why not operate the receiver with the station license? If a converter is used and if the i-f frequency is chosen so that the converter oscillator frequency falls within the band, the "receiver" is legal, as long as appropriate signal identification is made. Solutions to automatic signal identification can be found in the literature pertaining to repeater operation. Straight C.W. keying of the local oscillator signal at 500 WPM is recommended. Undoubtedly other methods of unnoticeable detectable station identification of receivers could be developed.

Think of the fun of "receiver" to "receiver" contacts and QRP without a "transmitter!" Think of the new terminology-T/R ratio (ratio between transmitter power output and receiver power output), FS (frequency spacing between transmitter frequency and receiver frequency), etc. "VHF home construction to be stopped?" Not by a long shot!

John J. Duda W2ELV
Geneseo NY 14454

NATIONAL HRO 500 for sale new condition less than fifty hours, \$1195.00. Dennis Dressler, Rt 7, Topeka, Kansas, fone 913-478-4751.

HALLICRAFTER HT 46 Xmitter and SX 146 Receiver, with relay and books, will ship, \$175.00, perfect condx. 2 - TA 33 beams @ \$50.00. 1 - TA 33 Jr beam \$25.00. 1 - 40 ft. crank-up tower, \$75.00. W. Abrahams, Southview Ave., Middlebury, Conn. 06762.

2 METER AM Clegg 22'er transceiver like new \$75.00. J. A. Smith, Box 2065, Newburgh N.Y. 12550. Tel. 914-562-4300.

"1971 TESTS–ANSWERS" for FCC First and Second Class License – plus – "Self-Study Ability Test." Proven! \$9.95. Satisfaction guaranteed. Command, Box 26348-S, San Francisco 94126.

2-METER FM IC-20, solid state, state of the art, fully Xtaled, w/mike, m-mount, & other accessories. \$220. Bob Brunkow, 15112 S.E. 44th., Bellevue, WA 98004.

A TRANSFORMER for linear builders. Tapped 115 v. pri. Sec 1050 v at 1 amp. C.T. Can be used in bridge circuit for sweep tube or in a doubler circuit would furnish over 2900 volts at 500 ma. for zero bias triodes. Sealed case. \$14.95 plus shipping. Wt. 47 lb. Can be shipped via U.P.S. A.R.C. Sales, 181 E. Wilson Bridge Rd., Worthington, Ohio 43085.

SAROC SEVENTH ANNIVERSARY January 6–9, 1972. Advance Registration \$9.00 per person entitles registrant to SAROC Special room rate \$12.00 per night plus room tax, single or double occupancy, effective January 4 through 12, 1972; tickets for admission to technical seminars, HAM RADIO MAGAZINE and SAROC Happy Hour Thursday, SWAN ELECTRONICS and SAROC Social Hour Friday, HY-GAIN/GALAXY ELECTRONICS and SAROC Champagne Party Saturday, Buffet Hunt Breakfast, Sunday. Ladies who register will receive transportation for shopping tour, luncheon and Crazy Hat program at the New Union Plaza Hotel downtown Las Vegas, Saturday. Advance Registration, with Flamingo Hotel mid-night show two drinks, \$14.50. Advance Registration, with Flamingo Hotel Dinner Show (entrees Brisket of Beef or Turkey) no drinks, \$17.50. Tax and Gratuity included except for room. Frontier Airlines SAROC group flight package planned from Chicago, St. Louis, Omaha, Denver, send for details. Fifth National FM Conference. ARRL, WCARS-7255, WPSS-3952, MARS, meetings and technical sessions scheduled. Accommodations request to Flamingo Hotel, Las Vegas, Nevada before 15th December. Advance Registration to SAROC, Southern Nevada ARC, Inc., Box 73, Boulder City, Nevada 89005, before 31st December.

TELETYPE PICTURES for sale. Vol 1 \$1.00. Vol 2 \$2.00. Vol 3 \$1.50. All for \$4.00. Perforated tapes available. 200 different pictures. W9DGV-C, 2210-30th Street, Rock Island Illinois, 61201.

SALE. HEATH: HW-100 (includes CW filter), ac P/S, desk mike, spkr. Excellent! Firm \$300. M. Saltzberg, 9318 Edmonston Rd., Greenbelt, Md. 20770. 301-345-8412.

R-388 RECEIVER S/W mint condx. Trade toward TR-4, KWM-2A or best offer. NEED maint. manuals: GERTSCH FM-3 FREQ. METER W/DM-1 MONITOR and CMC 200B COUNTER. Have manuals for 535A, 545A and 511AD scopes and FR-67 counter. SASE for more items for sale. J. Jones, 118 Ohio Circle, Jacksonville, AR. 72076.

2 METER MOTOROLA HT-220 – 6 watt, 2 freq, with nickel-cadmium battery, like new in original carton. First \$289.00 money order takes. R. J. Morse, Box 5003, Columbia, S.C. 29205.

TECH MANUALS—\$6.50 each: R-274/FRR, TS-34A/AP, LM-21, BC-779B, BC-639A, TS-186D/UP, ARR-7, BC-348JNQ, SP-600JX, URM-25D, OS-8C/U, CV-591A/URR, TS-323/UR. S. Consalvo, 4905 Roanne Drive, Washington, DC 20021.

SELL: Limited quantity of 12FR8 tubes, \$8.50. 20A exciter and VFO, \$95. Cressman, 327 N. Prospect St., Washington, New Jersey, 07882.

FOR SALE: Lampkin 105 B with all manuals, used very little, \$150.00, will ship. W9PPP 1305 Jefferson Street, Racine, Wisc. 53404.

FOR SALE: Heath HW-100, HP-23a SB-600, Turner 350-C Mike, \$270. Bert O'Connor, 16 Smithshire Andover, Mass. 01810.

PROFESSIONAL SERVICE – for your quality ham gear. Moseley Antennas distributor. For information or shipping instructions send card to South Shore Radio Phone, Inc., Municipal Airport, Marshfield, Mass. 02050 or call (617) 834-6900 and ask for Dave W1AAI. A very complete facility with plenty of experience to help you.

GALAXY FM-210 w/Power Supply, Mobile Bracket, Three Sets Xtals. Unit has all engineering changes, will not drift. \$165.00. P.O. Box J, Lincoln, RI 02865.

FM-210 used for editorial writeup in 73 available complete with ac power supply and crystals for 34/94 and 94/94. \$300 value goes to the first check for \$145 received. Box A, 73 Magazine, Peterborough NH 03458. FM-210 crystals \$2.50 each, Transmit 22, 28, 46, 37, and receive 82, 88, 73. While they last. Box B, 73 Magazine, Peterborough NH 03458. 1000 kHz crystals \$2.00. Box C, 73 Magazine, Peterborough NH 03458.

SOLID FIBER OPTIC: 35 ft., 1/16 in. dia., PVC jacket – 75¢. 500uf–50WVDC electrolytics – 5/ \$2.00, 10/\$3.50. Postage plse. Electronic Systems, PO Box 206, New Egypt NJ 08533.

WANTED #195154 GEARSHIFT FOR MODEL 28 ASR. Also M28 LPR-9 Reperf. For Sale: Model 28 TD LBXD Excellent. 60 WPM with cover, \$90.00 F.O.B. Larry Kleber, K9LKA/W9CPD, Belvidere, Illinois 61008.

STUDY for your first phone license at your own pace using the highly-successful Bell & Howell (DeVRY) courses. Contact Bill Welsh (W6DDB), 234 S. Orchard, Burbank, Calif. 91506.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland, CA. 94607, 451-7755, area code 415.

2M FM, standard 826M, Hustler BBLT-144 ant., extra crystals for 19/73, 22/76 repeat., all 2 months old. \$290.00. J. Solomon, 24 Brookfield Lane, Centereach, N.Y. 11720.

ALMOST FREE. Taped code lessons. Beginners to 5 wpm. Refundable deposit on tapes, \$1.00 for postage. Tomlinson College Radio Club, 3637 West Grandview, Tacoma, Wash. 98466.

COLLINS crystal pack \$150.00. Linear Systems 500–12 mobile power supply \$80.00. Hi power linear xformer 2500v @ 3 amp. \$40.00. All items like new! WA5ZWO, P.O. Box 35128, Dallas TX 75235.

HOT GEAR

Stolen from locked car in driveway at home, night of August 17, 1971: REGENCY 2 (incl mic), Serial: 04-03505. *T. Jeff Coffey, Jr. WA5BNM, 3102 Mindoro, San Antonio TX 78217.*

One Sonar FM-3601 2M FM Xceiver., ser. #1003, with 94/94 and 31/91 xtals. Stolen 8/28/71. *George Ritscher WB2ARM, 195 Colvin Ave. Buffalo NY 14216.*

Doug Gaines W4AXE
1226 Rolling Wood Lane
Lakeland FL 33803

A BIG THREE ELEMENT BEAM

(OR THE BIGGEST GAMMA ROD IN THE WORLD)

Three elements, 0.15-wavelength spacing, vertically polarized mechanically rotatable. Big deal! So what's so great about a three-element yagi? Well, really not much except this article is about such an antenna, designed, built full-sized, and operated during a DX contest for the 75m phone band!

During the contest season, I got the itch to do something different. How I decided on operating single-band on 75 phone is beyond me. I suspect a streak of masochism. I had the sick fantasy that it would be a lot of fun, especially if I could come up with a mind-blowing antenna that would rattle the boys in the northeastern U.S. loose from their monopoly of signals into Europe on 75m. Sick, sick, sick.

After several months spent experimenting with wire beams, 8JK's, Lazy H's, "bobtail" arrays and other mickey-mouse arrangements, I knew I was falling far short of my goal. In short, the W1s and W2s were eating me alive. Something a little further out was obviously needed if I was going to even partially make up for the handicap of operating from Florida.

While playing with vertical arrays, I got around to feeding my 125 ft tower. After quite a bit of fiddling, I found I could match it to coax with a huge gamma section, and it would actually radiate. This was not too difficult after I realized that the tower, plus the top loading of my six-element 20m beam, appeared to be $5/8\lambda$ long on 3800 kHz. Without going into a long discourse on verticals, I will just say that I put out six $\frac{1}{4}\lambda$ radials in very good earth at the grounded base of the tower and gamma matched the tower to 50Ω coax, using a gamma rod 3 in. in diameter and 38 ft long. Who knows whether the tower or gamma rod was radiating more? It worked fairly well, with a low angle of radiation, was rather narrowbanded – but was still only a vertical and had no gain.

While lying flat on my back in the yard one Saturday afternoon, properly fortified with a suitable quantity of cool 807s, and contemplating the tower (while there are

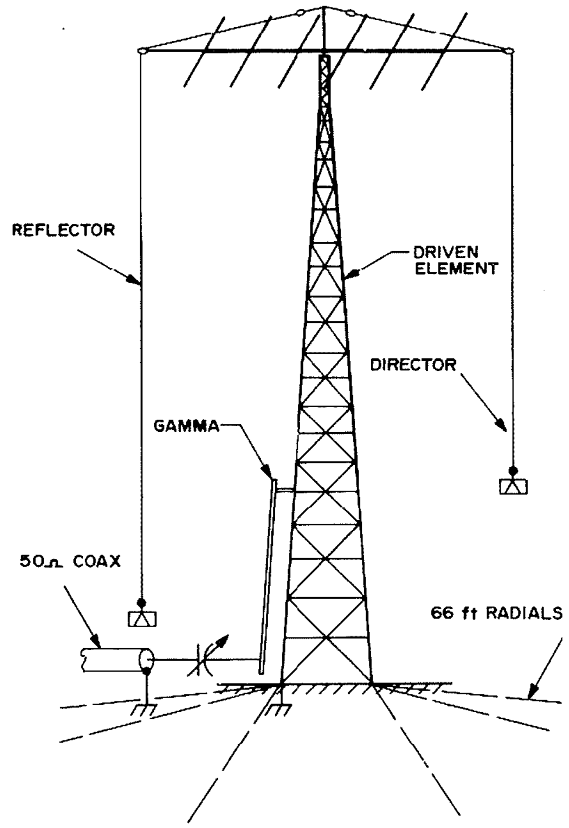


Fig. 1. The beam is a tower with a quickly and easily assembled wire contrivance to make the elements.

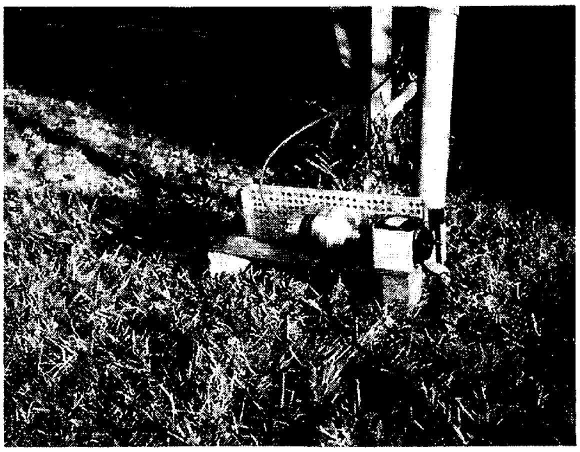
those who smoke pot and contemplate their navels, I guzzle beer and contemplate towers) I had a vision (hallucination?). Why not mount two more verticals, reflector and director, in line with the tower and make it a fixed array favoring Europe? In fact, why not hang the director and reflector from the boom ends of the 20m beam, enabling me to rotate them around the driven element (the tower) and I would have a full-sized, three-element 75m rotary beam.

Without going into too many details of neighbors burning crosses in my yard and chanting, "Fall, fall fall" every time I got on the tower, swinging elements nearly decapitating small children and FAA requesting I file a flight plan every time I rotated it, here is how W4AXE built and operated one of the most gawdawful looking (but electronically satisfying) mechanical monstrosities since the Chinese oyster-shucking machine.

Figure 1 is a sketch of "The Thing." The tower, a self-standing 125 footer, 22 ft across at the base, tapers to a mast which makes the entire structure 136 ft high. At the 125 ft level, I had only my 20m beam mounted at the time. Its six elements on a 46 ft boom made it an excellent top-loading capacity hat that I really didn't need, as the tower would have been much easier to load if it was a half wavelength long. The reflector was calculated and cut 136 ft long, and the director length was chosen to be 112 ft long.

The parasitic elements were strung from the very top, over outriggers mounted to the boom, and down vertically, parallel to the tower and 36 ft away from it. They were number 12 copper-clad steel wire, held taut by weights consisting of two paving bricks hung on each lower end. No attempt was made to restrain the lower ends or keep them constantly spaced from each other and the tower during rotation. This "letting it all hang out" technique resulted in some startling geometry changes from centrifugal force during rotation.

Some losses were probably incurred by having to bring the upper ends of the director and reflector close together at the mast top. This was necessary to pull the gyrating element ends, with their lethally swinging bricks, high enough to clear trees, children and a neighbor who lives for the day he can have something to sue me for. (He almost had me later when his son lost a U-control model airplane to my 75m reflector. I got out of that one by getting the kid to imagine he was a Luftwaffe pilot trying to get his ME109 through the



"Das Flamenspitzer" gamma match with covers removed. Wine bottle insulator is empty, of course. CAUTION! MUCH HIGH VOLTAGE!

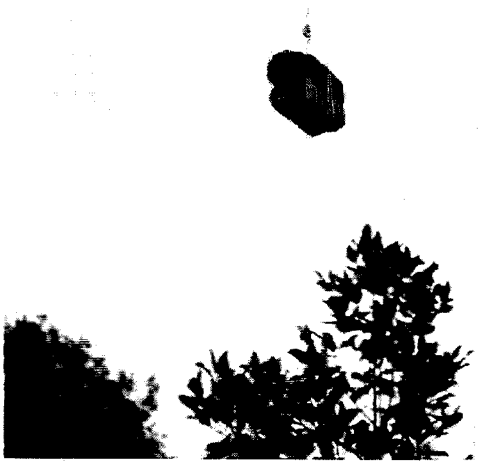
barrage balloons during the Battle of London.)

The matching system consisted of a 38 ft gamma rod constructed from 3 in. irrigation tubing (hope certain grove owners don't read this!) and a 25–1000 pF vacuum variable capacitor. Why a vacuum variable? Because I could develop a jillion volts across the gamma capacitor with a kilowatt. Observe the photograph of the lower section of the gamma match, affectionately called "Das Flamenspitzer" by those who have stood too close to it. Note also the dead grass.

The outriggers were constructed of 2 in. aluminum tubing with drilled Micarta insulators plugged into the ends. The wire elements were first strung through the holes drilled in the insulators and "conveniently" coiled until after the outriggers were clamped to the boom of the 20m beam. (Conveniently – Hah! Have you ever tried to handle 250 ft of copper-clad steel wire while on top of that size tower?) The upper ends of the wires were mounted through strain insulators to the top of the mast. The outriggers were fastened to the boom using – sigh! – baling wire, and the coils of wire were heaved almost over the ends of the beam to fall toward the ground. I did a lot of heaving that day. That "almost" cost four hours, at least a pint of blood and visits from two local clergymen concerning the language broadcast from the top of my tower. The name of the game was "untangle the wire – coil it – and throw it again – and again – and again.

Finally, after getting the ends hanging clear and weighted by the bricks, I gave one last look to make sure all was hanging properly and entered the shack to try her out. I rotated the whole mess to where I thought it would favor Europe. Verrry nice! the swr was approximately 678:1 and the rf on my mike did away with the need to shave one side of my face again.

Visualize, if you will, the endless trips out to the tower, up said tower to adjust the 38 ft gamma rod, down the tower to adjust the capacitor, back by the beer cooler and finally into the shack for another measurement. Sad, but inspiring!


Weighted end of reflector. (Heads Up!)

At one time that night, I had the swr adjusted down to 662:1, I think, or else the bathroom fluorescent light finally gave up and burned out. At any rate, the good fight was given up at 2 am.

Stretch your visualizer a little further and imagine the chagrin, but delight, the next morning when it was discovered by the light of day that the reflector and director had hopelessly tangled with themselves and the tower, probably during the first rotation the night before. Apparently rotation of this antenna should be done as the hippies take baths, slowly and only when absolutely necessary. Once again, I will spare the reader the details of untangling "Godzilla," and will simply say that it was ready to go by noon that day. Unfortunately, I was not. By 6 pm I had recuperated enough to try again to tune my brand new but badly wrinkled 75m beam.

As if to make up for its earlier misdemeanors, the array tuned beautifully. The gamma rod required about a 2 ft adjustment and a lot of gamma capacity was needed, but the swr could be adjusted down to 1.2:1 on 3800 kHz. A quick tuneup and call while beaming northeast rousted three Europeans and a covey of surprised W1s and W2s. Ah so! New Yorkers no longer able to brush aside obnoxious

W4 who is working their DX. Velly intelesting!

Forward gain checks were made against my inverted-vee up 120 ft, favoring Europe. The three elements acted just like any lil' ol' yagi is supposed to. It showed about 6 dB gain stateside and, heh, heh, heh – about 9 dB gain on long-haul DX. The pattern would not make Messrs. Yagi or Uda very happy – the front-to-side ratio only about 30 dB and the front-to-back ratio about 16 dB, but who's going to tune it? At any rate, you would be surprised how many requests we received concerning information on our secret weapon from amateurs all over the Eastern Seaboard who had heard our 75m QSOs and pattern checks. I say "we" – you ought to hear my nontechnical wife describing this array over long-distance telephone to some ham who has called at 1 am.

Modesty prevents too much discussion along these lines, but a quick perusal of contest results for the 75m section of Brand X's Worldwide DX Contest will attest to the fact that this antenna does work. The only guy to beat me out in this continent was W1FZJ/KP4, a bigger nut than yours truly, reputed to be running 75m cubical quads up 175 ft high. (Yes, Virginia, there is a Sam Harris, and he is hiding out in the wilds of Puerto Rico – with a lot of wire.)

The Great Happening is over. The tower is now festooned with "normal" six-element beams on the high bands and "IT" is no more. The wire resides in some trash dump after I cut the whole thing down and the resulting tangle was judged hopeless. Children, wild game, model airplanes and my wife can again run free and gay, no longer under the shadow of brick-loaded copper scythes whistling over their heads as I crank up the prop pitch voltage chasing a quick band change. But the memories (and lawsuits) linger on. I can still occasionally come on 75m, and a W2 will hesitate to see if I am still running "IT" before he jumps in with both feet and runs me back up to 20.

I've never tried 160m in a contest. Hmmmm.

. . .W4AXE■

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Remote Tune Your Groundplane

To achieve optimum performance (and minimum swr, of course) with a groundplane, the length, diameter of the vertical element, and position of the ground radials are critical. The groundplane cannot really be classified as a broad-band device, so for maximum efficiency it must be retuned for different segments of the particular band you are operating.

When the groundplane is in resonance at the operating frequency, the position (angle) of the ground radials will determine the impedance of the system. If the ground radials are exactly 90 degrees in respect to the vertical element, the impedance is approximately 30Ω. An additional 45 degree lowering of the radials will incease the impedance to approximately 50Ω, which is a match for conventional RG-8/U coaxial cable.

With a groundplane antenna mounted 50 ft high on a mast, it becomes quite difficult to adjust the resonant length of the vertical element. The position of the ground radials is easily changed as they usually are part of the guy-wire network. The physical length of the vertical element must be changed to achieve resonance and to present an optimum match to the transmission line. Electronic methods for increasing or decreasing resonance of the vertical element can be devised but usually a system of capacitors and loading coils introduces loss and inefficiency. To obviate this, I devised a method of remotely changing the true physical length of the vertical element conveniently from the operating position.

My groundplane was cut exclusively for operation on 20 meters. To cover the entire band with exact resonance, the vertical element had to vary in length from 16 ft 5 in. to 16 ft 8 in. This meant evolution of a device that would mechanically increase or decrease the physical length by 3 inches.

With the aid of a small reversible ac motor, it is actually quite easy and inexpensive to devise an acceptable remote tuning method. Reversible ac motors can be salvaged from discarded TV rotators. The majority of these rotor motors run on 24V ac with capacitor start.

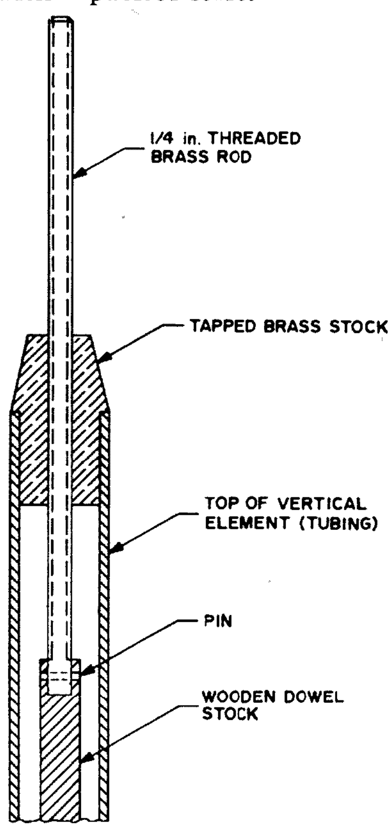

Fig. 1. Vertical top section.

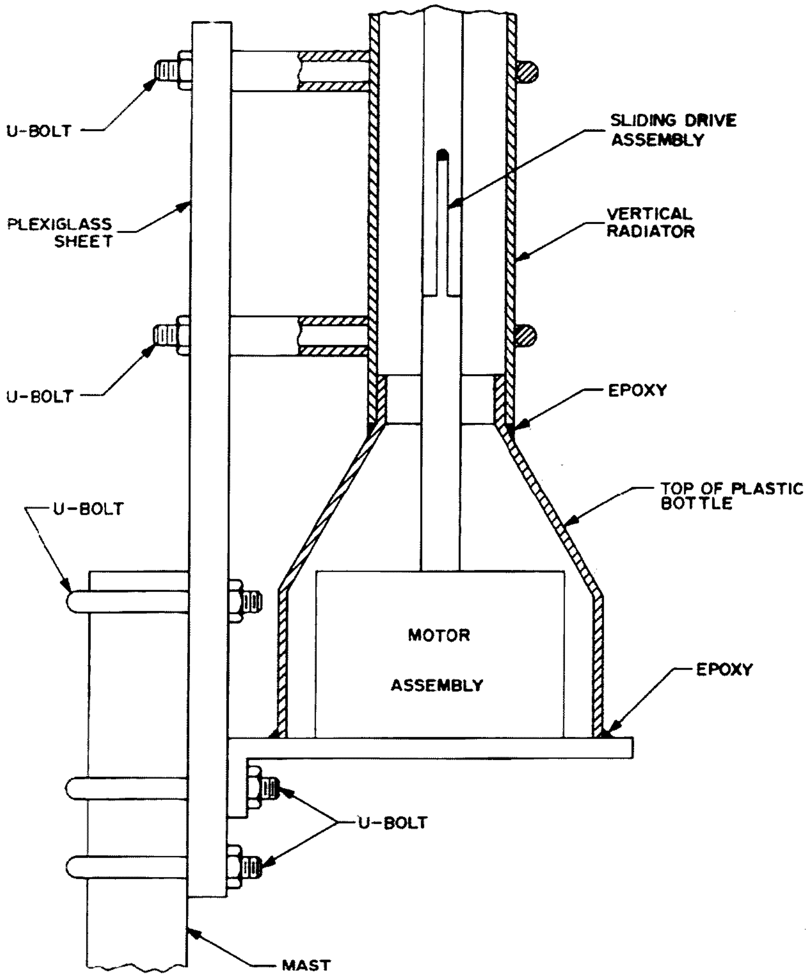

Fig. 2. Bottom drive assembly.

Most groundplanes are constructed with the vertical element made of metal tubing. All that is necessary is to cut a piece of solid brass stock so that it can be securely inserted in the end (tip) of the vertical element. Two 6/32 screws are used to retain the brass stock (after drilling and tapping) in the end of the vertical element. Before inserting the brass stock in the "whip tip" I drilled and tapped a ¼ in. hole vertically through the stock. A 10 in. piece of ¼ in. threaded brass stock is made up to fit the drilled and tapped hole. Care must be taken when tapping and threading this so that the ¼ in. threaded brass rod will turn freely but securely for good contact. In fact, it might be wise to use a matched tap and die set to do the job. Good contact must be made as voltage is highest at the tip of a ¼-wave groundplane.

Wooden dowel stock is run the entire length of the vertical element and pinned to the threaded brass rod. Dowel stock is easily obtained in almost any length from lumber yards. The weight of the dowel attached to the brass rod will assist in maintaining good contact along the threads.

If you are a real perfectionist, the entire tip assembly could be silver plated for optimum contact. Even after oxidation, silver is still a very good conductor. For protection against weathering, a plastic pill bottle was placed over the tip of the vertical. Ordinary plastic electrical tape will hold the bottle in place nicely and will establish a weatherproof seal.

The bottom portion of the vertical element is insulated from the mast with ¼ in. Plexiglas sheet stock. U-bolts hold the Plexiglas sheet to the mast and the vertical element to the Plexiglas. The reversible drive motor is also attached to the Plexiglas sheet with "L" stock fashioned from 1/8

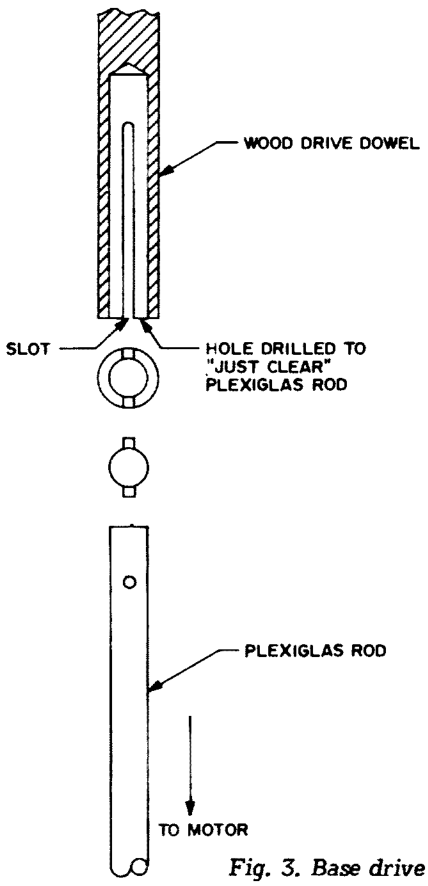

Fig. 3. Base drive details.

in. aluminum. The shaft of the reversible motor is centered exactly with the center of the vertical element. A short shaft from the motor to the wooden dowel is constructed from plastic rod. Almost any rod with good insulating properties could be used here.

Due to the screw action of the brass stock moving up or down as the groundplane is tuned, the wooden dowel must also be free to move up or down. The lower end of the dowel must be drilled so as to freely accept the plastic rod from the drive motor. A slot is then cut in the dowel to allow travel of a pin which is inserted in the top of the drive motor insulated shaft. Drive will still exist yet the dowel will be free to move up or down.

The top section of a plastic bottle was cut off and fitted into the base of the vertical radiator and over the motor assembly to shield from weathering.

TV rotor cable was run from the drive motor back to the shack and control head.

With this remote tuning, you merely watch your swr meter and tune the vertical for minimum reflected power as you move about the band. . . .W2AOO■

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HIGH MAST LOW PRICE

Joining the DX fraternity usually involves a common price of admission: a tower. If you're still collecting your dues, here's an inexpensive mast to use in the meantime.

When the DX bug bit me a few months ago, the spirit was willing but the antenna was weak!

My stalwart skyhook at that time was a dipole. It had faithfully delivered WAS, but when my attention turned to DX the new ones were a struggle. Feeling that my race with a declining sunspot cycle might have a sorry end, I made the decision to put up a modest beam.

Commercial towers were certainly the best bet from many points of view, but since funds were lacking, an economical interim measure had to be devised.

Since my plan was to put up a lightweight two-element 15m beam, the mast support had to be adequate to support this plus a TR-44 rotor, but not necessarily a monster called for by "big bertha" arrays. Another consideration was in making the mast fairly self-supporting. This part was easy, since the only available space was alongside the back of our house – the back yard was already criss-crossed with dipoles so that the air space there was already spoken for!

The house had been used to supply bracing points for a 15-ft mast holding my 2m VHF yagi. My question was whether or not this same approach would work in supporting a bigger array. A discussion with a local plumbing contractor who also happens to be a ham resulted in the decision to improve upon the pipe mast idea, but with heavier pipe than the 1 in. galvanized type I had been using for the VHF installation.

The resulting mast was 32 ft high – more than adequate to boost my 15m beam to an altitude that would produce a low wave angle. The mast was constructed of two sections of pipe: The bottom portion was a 20 ft length of 2 in. iron pipe, while the top section was a 15 ft length of smaller-diameter pipe.

The most important part of building a single-section mast of this kind is coming up with a technique for joining the individual pipes together to form a single, rigid sky needle. In the case of this mast, the smaller diamater top section is designed to slip inside the larger diameter bottom pipe for an overlap of three or more feet, with the two pipes then screwed together by means of a threaded reducing coupling welded to the top piece of pipe (Fig. 1).

Securing pipe for the mast can be done via the usual sources, but care should be taken to insure that the bottom pipe is threaded on one end and that these threads

match those of the coupling. With a helpful welder, the pipes and coupling can be on hand and the amount of overlap determined prior to welding the coupling. During the welding, the coupling must be kept in the true vertical position, and this can be accomplished by slipping a temporary sleeve underneath. The idea here is to insure that the pipes form a single vertical section when assembled.

Equally important as the mast itself is the bracket-system used to hold the mast firmly to the side of the house (Fig. 2). I used a series of three supports placed at equal intervals, with the top one located just under the gutter about 12 ft above the ground. The supports were made of wooden standoffs that had grooved ends in which the mast rested, and a turnbuckle-and-strap combination that pulled the mast snugly into the bracket and securely in position.

The supporting brackets were made from pieces of 2x4. Semicircular cuts were made in the end of each bracket of a size slightly greater than the diameter of the pipe. The bracket length should be calculated so that when installed on the side of the house it will support the mast clear of any protrusion such as gutters. I used a series of angle irons and long wood screws to attach the brackets to the house. Care should be exercised to insure that the brackets are lined up accurately so that the mast, when installed, will be perfectly vertical.

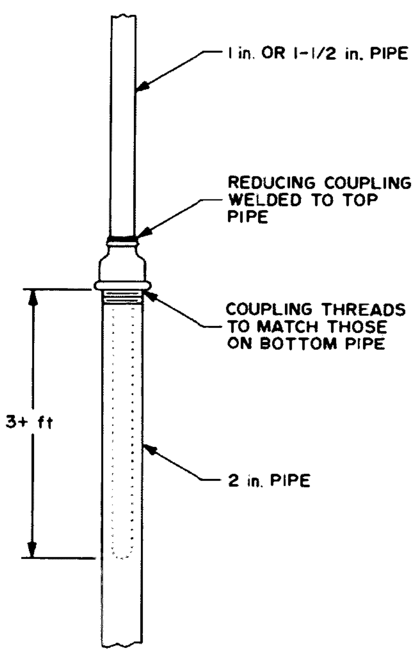

Fig. 1.

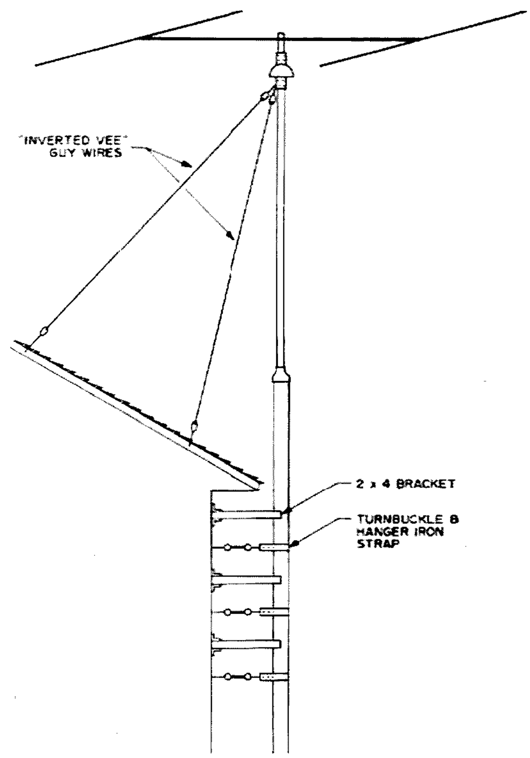

Fig. 2.

The turnbuckles holding the mast snugly in the brackets are attached to joists in the side of the house by means of long screw eyes. Strap iron is wrapped around the mast after it's installed and screwed on to the end of the turnbuckles which are then tightened sufficiently to insure stability.

Installing a mast of this type can be accomplished via any of several techniques described in the literature. I opted for a rather direct approach, since my house is a single-story structure with a gently sloping roof that allowed a member of the antenna party to operate "topside."

The first try at getting the beam airborne was to simply walk it up, but this was a near disaster and quickly abandoned. The approach that was quite successful might be dubbed the "divide and conquer" tactic. With the mast lying on terra firma

and the beam-rotor assembly in place, the two pipe sections were disassembled. Then, the top mast section containing the beam was lifted to the roof with its lower end extending over the edge of the roof. Then, raising the bottom section of the mast and mating the two pieces, a pipe wrench was applied to the task of reassembly by a helping ham standing on a ladder. After the mast was together, the man on the roof (supported with a safety harness) pulled while the rest of the party pushed the mast skyward and into the brackets. The final measure was to tighten the straps and turnbuckles to lock the mast into position.

The mast withstood 60 mph winds last winter with nothing more than a gentle swaying motion. But since the rather inexpensive beam design led to strong element torque and the eventual snapping of an aluminum gamma strap, I lowered the beam this spring and beefed up the hardware considerably. One valuable improvement was the addition of a pair of guy wires which were actually a 20m inverted vee anchored to each end of the house. The resultant guyed mast is adequate to withstand most severe storms and performs very well.

Certainly the mast described here could be improved via some form of tiltover mechanism and the addition of several more guy wires, but for the money, the mast certainly does the job. . . .WB2FBF■

A GAIN VERTICAL ANTENNA for 2 METER FM

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Most amateur FM activity in the United States is vertically polarized to facilitate easy contact with mobile stations. Thus, amateur base stations have tended to utilize whatever type of vertical antennas available. Generally, these antennas consist of groundplanes, obsolete commercial gain antennas, and modified mobile antennas. These antennas are quite satisfactory in many applications; however, when more signal is needed in an omnidirectional pattern, various types of antennas begin to look less desirable. The groundplane is often used as the standard 0 dB reference and thus is the first antenna to show deficiencies. The various types of commercial gain antennas are often the most desired types. Of these, the "Croppie Pole" is among the best. But these are quite expensive and hard to find. Thus, the amateur FM'er often resorts to mounting a gain mobile antenna (such as the Antenna Specialists ASPS 177) with radials, on a tower or mast. Unfortunately, these antennas are relatively expensive and present somewhat of a compromise in mounting.

In each case the antenna is almost always fed with some type of coax, most often a 50Ω low-loss type. If the run is quite short, this present no major problem. But, as line length increases (as happens when the elevation of the antenna is increased) the line loss increases considerably. Thus, the point is soon reached at which all gain realized, in either the antenna height or in the antenna itself, is absorbed by the feedline. For the disbelievers, RG-8/U has a loss of approximately 2.7 dB per 100 ft at 150 MHz (solid center conductor), and the more common RG-58C/U (stranded center conductor, noncontaminating jacket) has a loss of approximately 6.8 dB per 100 ft at 150 MHz. In contrast, 300Ω

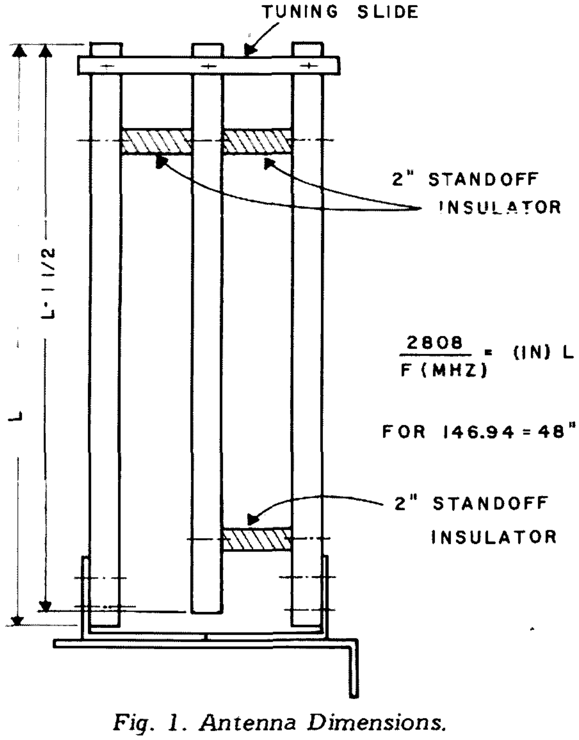
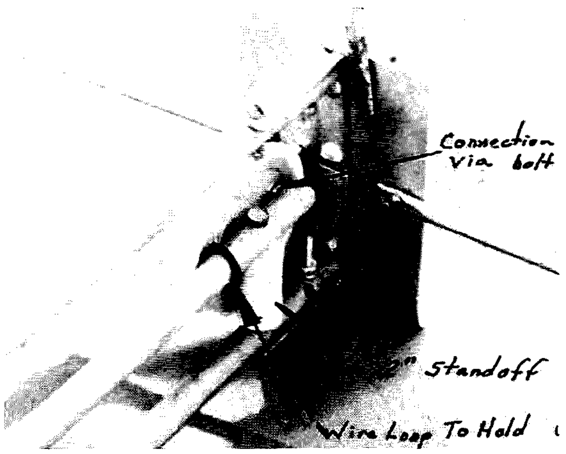


Fig. 1. Antenna Dimensions.

twinlead has losses of from 1.0 dB per 100 ft to 1.5 dB per 100 ft at 150 MHz in dry weather and from 1.0 dB per 100 ft to approximately 10.0 dB per 100 ft in wet weather.

The minimum effects of wet weather are found in the jacketed (not shielded) twinlead such as Belden 8285 and in tubular twin lead such as Belden 8275. The worst losses occur when common flat twinlead is used. Best all-weather 300Ω conditions are met with 300Ω open line. Losses range from about 0.5 dB per 100 ft at 150 MHz when dry to 1.4 dB per 100 ft when wet. However, open wire line is hard for many amateurs to work with. Thus, either the jacketed twinlead or open wire line is the most desired, depen-



Remainder of Mounting Details. Note mounting of dish cover.

ding on individual preference in terms of ease of working the line.

By now everyone must be questioning the reasoning behind the argument for 300Ω line. After all, aren't RG-8/U and 50Ω feed antennas the only thing practical in vertical antennas? Well, the commercially available antennas, excepting beams, are generally 50Ω feed, as are most antennas found in amateur reference books. However, there still remains the three-wire vertical. This antenna is basically one half of a three-wire folded dipole (600Ω feed) working against ground. Since it is only one half, the step-up ratio is changed and the impedance is only 300Ω. This antenna, when increased from its original ¼ wavelength to 5/8 wave-

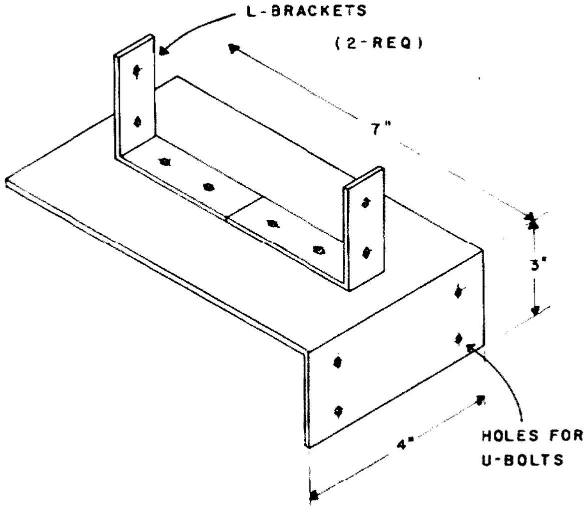


Fig. 2. Mounting Bracket Detail

length, will exhibit a gain of approximately 3 dB over the usual ¼-wave groundplane. Also, the 300Ω feed allows use of one of the three desired 300Ω feed lines with decreased line losses. The 300Ω balanced line may be matched to the coax input of the FM unit by a simple balun.

The antenna may be constructed from aluminum tubing or steel conduit. Aluminum is much lighter in weight, but conduit is readily available.

Construction is straightforward. Three pieces of conduit are cut to length (per Fig. 1 or formula). At one end, two of the insulated standoffs are used to space the three sections. At the other end, only one is used to separate the center element from one of the outside elements. Next

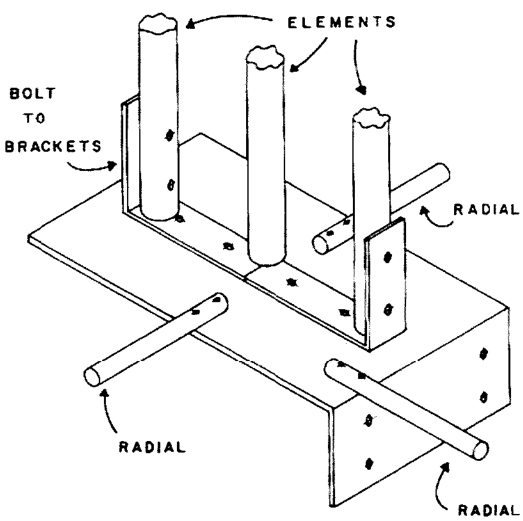


Fig. 3. Mounting of elements to bracket.

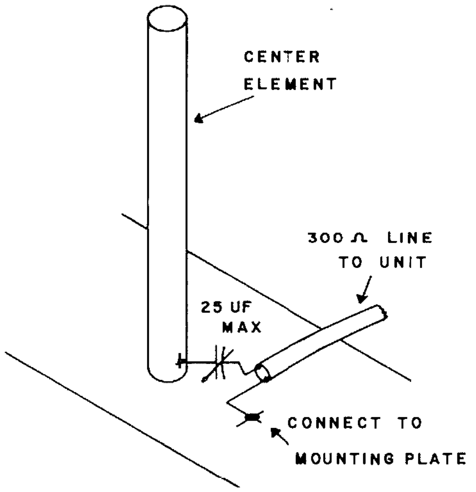


Fig. 4. Coupling capacitor installation detail.

the sheet of aluminum is bent per Fig. 2. The L-brackets are attached end-to-end as in Fig. 3 and the photographs. Next, the holes for the U-bolts are drilled in the sheet, as in Fig. 3. The conduit assembly is next attached to the L-brackets. Three or four radials 20 in. long are attached to the base by small bolts. The variable capacitor is mounted inside the plastic dish with only the shaft protruding. Attach a knob to this to insulate the shaft while tuning. The capacitor is wired per Fig. 5. The feedline may be attached directly to the capacitor or by use of a terminal strip as in the photographs. The plastic container may be mounted by attaching the cover to the center element with small bolts and then snapping the remainder of the assembly in place. The purpose of this dish is to protect the matching capacitor in wet weather.

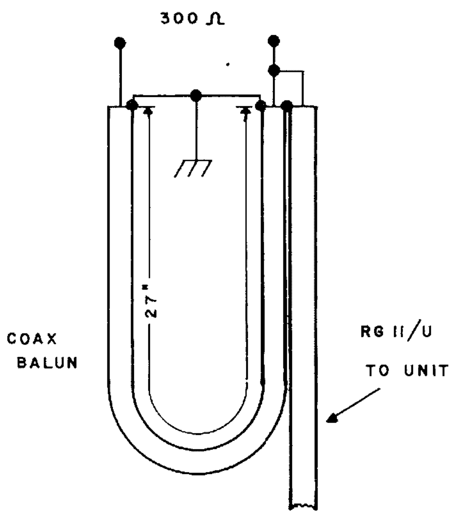
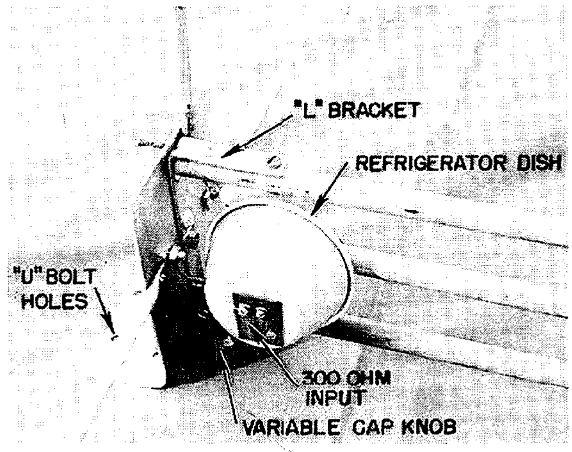


Fig. 5. Details for construction of balun.

To match the coax input of most FM units, a balun is needed. Such a balun may be made from 29 in. of coax (polyethylene, not foam) as described in Fig. 6.

Tuning of the antenna is similar to tuning a gamma match. A slider must be made and the length of the effective antenna adjusted while watching a VHF swr bridge or wattmeter. Also, the matching capacitor should be adjusted for optimum match. Since the two adjustments interact, it will be necessary to go from one to the other several times to achieve optimum settings. When the optimum



Partial Mounting Details. Note use of carpenter's "L" Brackets and Refrigerator Dish.

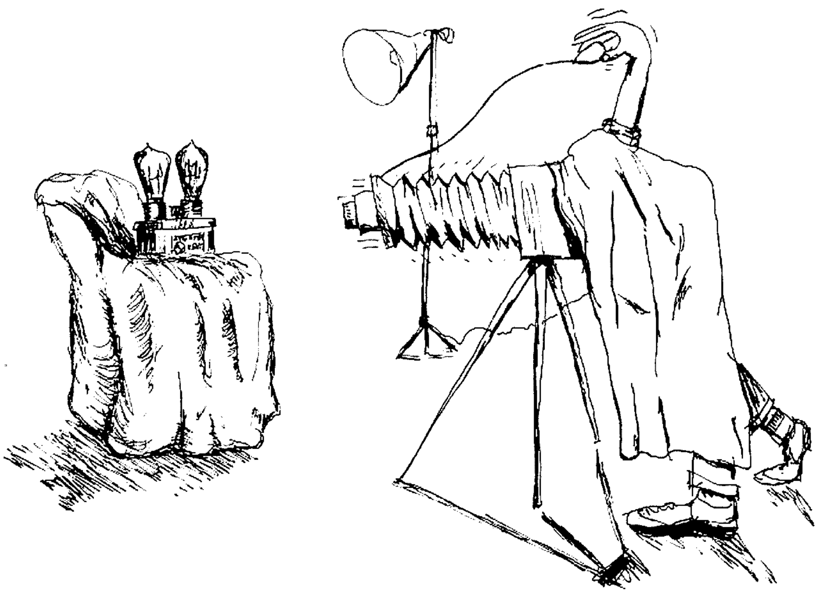
length has been found, the strip of aluminum is attached with sheet-metal screws to the three elements to provide a permanent short. In a pinch, the antenna may be adjusted with a received signal by watching the limiter readings.

The final step is to mount the antenna as high as possible and then run the feedline. Normal practices concerning open-wire line or twinlead should be followed.

The prototype antenna (shown in the photographs) was compared with both a groundplane and an ASPS 177 antenna. Gain over the groundplane was approximately 2.7 dB with the three-wire vertical, and 3.1 dB with the ASPS 177. These were with line lengths of less than 10 ft. This antenna can be made to work on other bands by varying the length and size of the tuning capacitor.

. . K9STH■

Photographing Radio Equipment



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Mystic CT 06355

If you can't bring a piece of "home-brew" equipment to a club meeting or adequately describe it in correspondence, why not simply photograph it? This article is not intended for photo hobbyists but for radio amateurs who own simple camera equipment. It describes how such equipment can simply but adequately be used to photograph small electronic units.

Often it is desired to photograph a piece of equipment for purposes of illustrating it to someone else, preserving a record of the construction used, etc. Since equipment is constantly growing smaller in size, the type of photography necessary becomes increasingly concerned with taking closeup photos. Of course, closeup photography of radio equipment is generally similar to taking closeup photos of any object, but there are some special considerations involved. This article tries to discuss those considerations and the general subject of taking simple closeup photographs. The information is certainly not intended for the advanced photo hobbyist, but for the amateur who has an inexpensive to expensive general purpose camera and who has often desired to photograph some equipment but not known how to proceed.

Camera Types and Lenses

Perhaps the first thing that should be mentioned about any camera that is available is that one must be able to take reasonably sharp photos with the camera used under *normal* conditions. If this cannot be done, there is no sense in trying closeup equipment photography. If it can be done, it should be completely possible to make reasonably sharp closeups with some practice.

Unless one owns such a camera as a Mamiya Macro which will focus down to 2½ inches, a twin-lens reflex type with a built-in lens bellows, etc. it is necessary to place an auxiliary closeup lens on the camera used. The lens that is necessary depends upon the type of camera being used. Various makes of

cameras have auxiliary closeup lens sets available that will permit focusing down to a few inches. When using such auxiliary lenses with viewfinder cameras, the distance between the camera and the equipment being photographed must be that specified for the auxiliary lens. Usually, the instruction sheet that comes along with the camera manufacturer's closeup lens set will give detailed instructions. Generally, unless an adapter is placed over the viewfinder also, the viewfinder image will not be accurate at close distances. Often, manufacturers recommend constructing a simple wire-frame, as shown in Fig. 1 , which places the object to be photographed at the correct distance from the camera lens and also "frames" it. The metal frame is just made large enough so it doesn't appear in the actual photograph. One doesn't look through the viewfinder at all but simply places the wire frame over the object to be photographed. The system is simple but quite good, once the correct frame size has been established for a particular closeup lens/camera combination.

If one has a single-lens reflex camera, the object that is photographed appears in the viewing screen as it will appear on film, since the object viewing is through the taking lens and not through an auxiliary viewing lens. This remains true when auxiliary lenses are used, so one simply focuses while viewing regardless of the auxiliary lens being used.

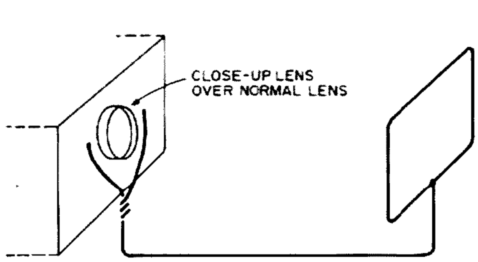

Fig. 1. Wire frame used to establish framing and proper distance from camera for object to be photographed using a closeup lens.

Again, camera manufacturers of single-lens reflex cameras provide auxiliary closeup lens sets for their cameras. However, since most cameras of this type accept standard screw-on auxiliary lenses (of a specific thread for a specific camera), one can use a wide variety of makes of auxiliary lenses. If the camera normally focuses down to about 3 feet, a simple +3 diopter lens costing a few dollars is a good start. It will permit the focus to go down to 8–12 inches, a range very useful for most small equipment or chassis section photography. If one really wants to have

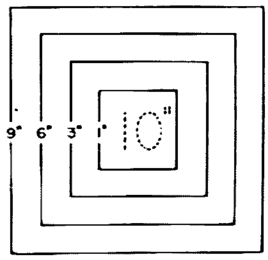

Fig. 2. "Test Pattern" used to test closeup lens. Made on brown paper or cardboard, number in center is changed according to camera distance. Squares (or rectangle for rectangular film formats) establish approximate frame size for different distances.

versatility, instead of buying various fixed diopter closeup lenses an investment in a Vari-closeup lens (about $20–$25) might be desirable. It is variable from +1 to +10 diopters, with a resultant focus range of 1–2 inches to about the camera's normal minimum focus distance. Such a variable diopter lens can also be used with simpler viewfinder cameras that accept screw-on auxiliary lenses but the focusing distance for each setting used on the variable auxiliary lens has to be established by test, as described next.

One may also have a camera which does not accept screw-on auxiliary lenses and for which the manufacturer does not provide any form of closeup lens set. Such cameras can still be used for closeups, providing they take clear, sharp images when used normally. The first problem is obtaining a closeup lens that can be held somehow over the normal camera lens. Some experimentation is necessary in this regard and the simplest procedure is to bring the camera being used to a discount camera shop that carries a variety of lenses. Choose a +3 diopter lens that covers the camera lens. Since the camera will be used with care for closeups , a rugged mounting is not necessary for the auxiliary lens, although it must fit snugly over the camera lens and not wobble. For instance, I have used lenses held by masking tape on the

front of a camera without difficulty. The next step is to establish the focusing range. If the basic camera has a focusing range adjustment, set it on minimum range and shoot a test roll of film. A similar test roll can be shot with the basic camera focus adjustment set on specific values. Simple black-and-white film should be used and only negative development is necessary. The test films will quickly reveal the focus range, as long as the camera setup remains unchanged, and should be retained for reference. Once the range is established, a taking frame such as shown in Fig. 1 can be built, if desired.

Lighting and Composition

Closeup photos can be made outdoors in bright daylight if carefully done. One problem is shadows, unless the sun is almost directly overhead or unless the equipment to be photographed is propped to eliminate deep shadows. Shadows which appear minor to the eye often show up on photographs as being very deep and they obscure components details, etc. Another problem is reflection from metal cased components (transistors, transformers, etc.). The simplest solution is to spray the unit being photographed with something like Krylon dulling spray (similar sprays are available in photographic shops). The spray will not harm equipment and will also be found useful for indoor usage. Another solution to reflection and glare problems is to use a polarizing filter on the camera. Generally, the use of the dulling spray is the simplest and least expensive solution. Also, the surface on which the equipment rests should not produce glare. Simple construction paper or coarse surface brown paper make good surface materials.

Indoors one can attempt closeup photography using flash bulbs but a number of problems can arise. When using flash bulbs at distances of less than two feet, they often produce a too intense light and the "guide" numbers normally used are no longer correct for camera settings. Quite a bit of experimenting must be done to find the correct camera settings. Most often it will be found far easier and less expensive to purchase an inexpensive photoflood lamp outfit. A basic dual 300 watt photoflood lamp fixture with bulbs can be obtained for around $5! It will provide sufficient illumination to photograph equipment at 20 inches or less with reasonably fast outdoor type film. Also, one can generally get away without using some of the special filters that are necessary when using flash bulbs in order to prevent severe glare and unusual color effects.

The composition of a photograph should be directed at showing detail and also give some perspective or depth. Using the print copying accessory available for Polaroid cameras, for instance, one has an extremely simple method available to make closeups at about 6 inches, but since the camera would be looking directly down at a piece of equipment a very "flat" photograph results. Generally, some sort of side view is best as long as the lighting can be adjusted to eliminate deep shadows. Often, it is best to remove tubes or other large components from a unit and lay them nearby rather than have them remain in place and hide many other components.

Exposures and Films

If one owns one of the "automatic" types of cameras which both set lens aperture and shutter speed there is no exposure problem. The only exception would be a case in which the photocell used in the camera were not mounted by the lens barrel, or were not a through-the-lens type, in the case of single lens reflex cameras. If the photocell is mounted far to the side of the camera it may not read the same light condition as the camera lens sees when taking closeups. A few test shots can be used to determine whether the photocell reading is usable by using manual overide to set the camera aperture at various test openings centered about that determined by the photocell light meter reading. Exactly the same testing may be necessary using "manual" cameras with a built-in light meter but where aperture and shutter speed must both be manually set. Simpler cameras may only have a "daylight/shade" type setting. The "daylight" setting should be used when using photoflood lamps and some test shots made. When the setting between daylight and shade is of a continuously variable type instead of only click stop settings, test shots should be made

for a number of possible settings.

Until one has refined the technique necessary for taking closeups, simple black-and-white negative film should be used (ASA 100/125 speed). Inexpensive negative development only is necessary to check the results of test photographs. Later, when one is sure of the technique involved, prints—both color and black-and-white—can be ordered. Generally, if using photoflood lamps, most cameras can be operated at fast enough shutter speeds such that they can be hand held. If jitter in the photograph is apparent with hand-held operation several remedies are possible. Stronger lighting can be tried in order to increase the camera's shutter speed. Faster film can be used—up to ASA 400 as long as the slightly increased graininess over slower film is not objectionable. Or a tripod can be used to stabilize the camera. Quite adequate tripods are available even from the radio mail-order supply houses at $6-$10 which will suffice for a small camera. For maximum effectiveness a shutter release cable should also be used with the tripod so hand motion is not transmitted to the camera mount during exposure.

Summary

The taking of closeup photographs is both an interesting and very useful adjunct to radio equipment construction. The expense of a few photographs is far less than that involved in constructing a piece of equipment over again experimentally to develop a successful circuit, component layout, etc. Also, illustrating a piece of equipment to others is very much simplified and the taking of a piece of equipment out of operation, subjecting it to mishandling, etc., is avoided.

I have tried to present only the simplest basics of the closeup photography of radio equipment. For those who wish to explore the subject further, many excellent books are available (the Kodak series, for instance, which contains information applicable to a wide range of camera types). Finally, when buying auxiliary photographic equipment, one should use the same care and regard to prices as when buying amateur radio equipment.

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Biasing the Transistor Audio Amplifier

When building an audio amplifier using transistors, there is a temptation to follow religiously the values of biasing resistors recommended by some "authority." This authority often is a person who has built up a circuit, identical or similar, and who has been satisfied with the results obtained. Some people have labeled this as "the cookbook procedure," noting that it places blind trust in the original builder.

The true amateur of radio technology, however, seldom makes a Chinese copy of some other person's design. Often he adapts ideas to suit his peculiar purpose or to conform with parts available from his junkbox. Such originality is highly commendable, but it can lead to undesired results when the builder leans too heavily upon published information.

Active devices, whether vacuum tubes or transistors, vary in characteristics from one sample to another. This is very much the case with transistors. Because of this lack of uniformity, even the recommendations of manufacturers are "bogey" values, those to fit the average case. That transistor you took out of your junkbox or brought off a dealer's shelf may be a far departure from the average!

What, then, do you do? Well, you use the transistor you have, but you adapt the circuit component values to fit that particular transistor! This is much easier than it sounds, for certain component values can be nailed down initially. This limits the variables to only one or two for each stage. Look at Fig. 1. It shows a single-stage amplifier using a bipolar NPN transistor in the common-emitter configuration. "Black boxes" are used to show the input source and the output load. These may vary greatly in nature, and they cannot be ignored. You must take them into consideration when you are adjusting circuit element values for optimum performance.

In this stage, the values of CI, C2, C3, R2, and R4 usually are predetermined by factors relating to the stage gain and the range of frequencies to be amplified. We'll consider them to be fixed. That leaves only R1 and R3 as the variables. Let's see what we can do with them.

Consider R3 first. It has two purposes in the circuit. One is to guard against thermal runaway, that self-regenerating (or is it self-degenerating?) propensity of a transistor to increase its collector-to-emitter current increases. To head off this "everybody loses" rat race, you put R3 in the emitter circuit to introduce direct-current degeneration. Stated another way, as the dc component of the collector-to-emitter current increases, the IR drop across R3 increases and places an additional negative bias on the transistor's base, thereby tending to reduce the collector-to-emitter current. That's one reason. The other is to make that particular circuit insensitive to variations in transistor uniformity. This permits the user to replace the original transistor with another one without having to hand pick the replacement to insure identical characteristics.

We'll assume you are building an item for keeps; you don't plan to change transistors often. Therefore, you are not particularly interested in making the circuit tolerant of individual transistor characteristics, especially as you know that you'd be doing so at the expense of diminishing the stage gain. So you'd like to put in just enough resistance to insure that the transistor will

not suffer thermal runaway. That's not much, about 200Ω for a small-signal transistor and decreasing to about 0.1Ω for some power transistors. You can get some educated guesses about how much to use by noting the smallest values used in similar circuits.

That leaves you with only R1 to juggle. To set its value by any means other than "by guess," you'll need the services of an audio sine-wave generator and an oscilloscope. A variable resistor, with a maximum value of at least ten times that of R2, and an ohmmeter will make the job easier. Unless your af generator can be adjusted for a very low output voltage, you may want to put a potentiometer across its output as an additional voltage divider.

Now for the procedure. Put the variable resistor in as R1. Make very certain that the input and output loads and the collector voltage is that which you'll normally use. Then float the af signal into the input, introducing as little additional input loading as possible. Hook the oscilloscope

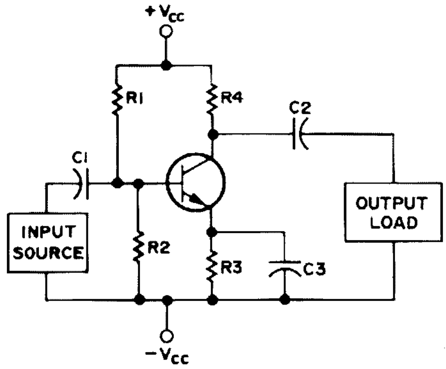

Fig. 1. In this circuit the front-end gain is "locked" onto the i-f gain and tracks with it.

across the output load and look at the waveform. If it looks horrible (after you've adjusted the scope, of course), reduce the input voltage until the waveform clears up. Shift the scope from output to input and back again to output to assure congruity of waveform.

Having obtained, initially, a good waveform, you next deliberately distort it by increasing the input voltage until the waveform shows limiting (flattening off) on one peak, either the positive-going or the negative-going. Adjust R1 to restore the waveform to sinusoidal shape. Then ruin it again by increasing the input voltage. Continue this cycle of actions until the waveform limiting occurs simultaneously on both the negative-going and the positive-going peaks. Now you can disconnect the variable resistor, measure its resistance with the ohmmeter and replace it with a fixed resistor of the same value.

Continue this procedure, stage by stage, until you've covered them all. You can leave the af generator on the input stage if it'll attenuate the signal sufficiently to prevent overloading the following stages. When you have completed the total operation, you can be assured that you have exercised proper technique in the final design engineering of an audio amplifier that'll deliver the maximum undistorted power output it can develop! And don't be shocked if you find that you've adopted values that are far, far departures from those shown in the cookbook. Yours are the correct ones for your situation.

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THE SPLIT SITE REPEATER

K. W. Sessions, Jr. K6MVH

Desensitization, as most repeater owners are all too aware, is the biggest single problem affecting repeater coverage. The pages of 73 Magazine have carried valuable information in the past on how to reduce this problem, and a great many pages of the FM Repeater Handbook (Editors & Engineers, Ltd., Indianapolis, IN) are devoted to methods for licking the problem. But by far the most effective technique, and curiously the one most often overlooked, is physical separation of the transmitter from the receiver. When this system is employed, the machine is said to be a "split site" repeater.

Getting a split-site system going is very often a considerably simpler process than repeater owners typically suspect. Getting a mountaintop facility in the first place – the basic repeater location – may prove to be a pretty sticky problem; but once it's in the bag there is seldom much difficulty in coming up with a second site somewhere in the general vicinity of the first.

Look at your own repeater location. Chances are you have some radio "neighbors" – commercial two-way or governmental radio facilities sharing the same mountain or hill. Ever think about asking one of them to let you install your receiver in one of their buildings? Maybe they'd like to split *their* site as well, taking a similar advantage of *your* site.

The advantages of operating a split site are obvious. Transmit and receive frequencies can be extremely close-spaced (no need to adhere to the 600 kHz requirement

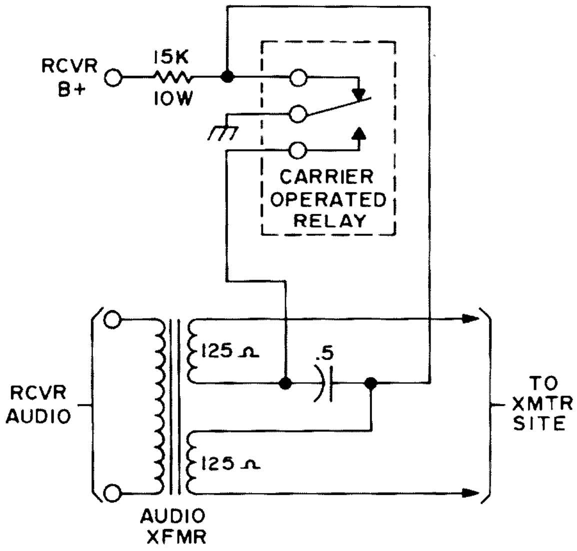

Fig. 1. At the receiver location (two-site repeater), a cathode follower feeds the receiver audio into a transformer continuously, but the receiver squelch keeps audio off the line until a carrier appears. The B+ leg of the two-wire line is held at ground potential by the normally closed COR. When a carrier appears, the ground is moved to the "return" leg and B+ is allowed to flow with the audio through the wire pair. The capacitor on the transformer secondary isolates the dc polarities without disturbing ac (audio) flow.

if you don't have to); receive capability can be enhanced by the addition of preamps without fear of rf degradation by high field strengths; input/output coverage can be matched to a fare-thee-well, making the range of the receiver equal that of the transmitter; shielding requirements are minimized or eliminated altogether, simplifying the installation.

One of the secrets of the fantastic 150-mile coverage radius of 73's WA1KGO repeater is the fact that the receiver and transmitter have been separated by a distance of one-half mile. With the receiver at the top of the mountain determining range, all that was necessary to balance up the system was to adjust the power output of the transmitter to closely match the coverage of the receiver when listening to a 10W mobile unit in a half-quieting area.

Getting the signal from one site to the other can involve secondary "link" setups – subsidiary repeaters operating on a UHF pair. Or it can involve leased telephone lines if the two sites are close enough to justify it economically. As a third alternative – and this is the approach used for the WA1KGO repeater – the two sites can be linked with an overground wire pair strung by the amateur repeater builders themselves. If the facility is on cleared and developed land, then this approach probably will be disallowed by the building owners or land leaseholders. But where the terrain between the two sites is high-foliage area, the homebrew wire-stringing might be just the right approach.

Even if you can't string wire overground, you might find no objections to undersurface wire-stringing – particularly when the landowner is made to realize that no unsafe voltages or currents are to be transferred over the line. Usually, undersurface wire is only required for esthetic reasons – which means you need bury it no deeper than the depth required to conceal the line.

A split-site repeater is no more complex than a single-site system; more often than not, as a matter of fact, it is even simpler. A standard single-contact carrier-operated relay at the receiver can do all the switching necessary to send both audio and dc control signals to the transmitter site. Figures 1 and 2 show one method for

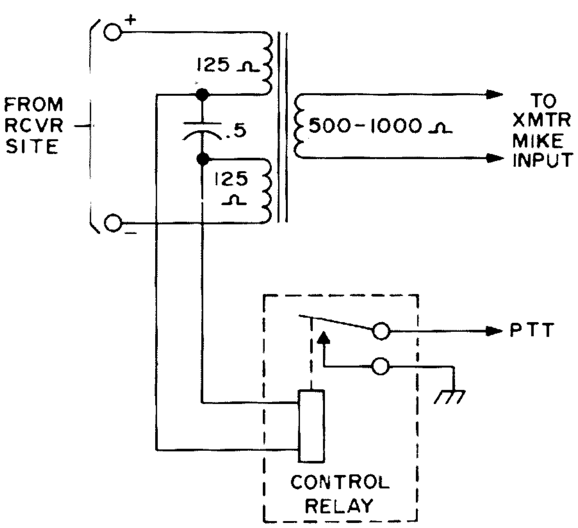

Fig. 2. Audio and dc decoupling is accomplished at the transmitter. The dc control voltage is used to trip a sensitive relay (10 mA) with a coil voltage of about 3500Ω which keys the push-to-talk circuit. The transformer, with split primary interconnected by a capacitor, passes the audio as the dc is routed at the primary.

accomplishing this dual function.

At the transmitter site, the audio and control signals are decoupled from the line by another transformer/capacitor arrangement similar to that at the receiver location, and the circuit is complete. There is nothing particularly critical about the impedances of the transformers in either the receiver or the transmitter circuits; this is particularly true where cathode followers are used, due to their wide impedance-matching range. The most important characteristic is the split windings.

Audio anomalies can be remedied by adjusting the isolation capacitor values. The values shown (0.5 μF) were selected for their ability to reject the clicks of dc relay closures. Lowering the value will improve the low-frequency response, but it will increase the likelihood of allowing annoying clicks to be transferred over the line.

Repeater owners sometimes appear reluctant to adopt a wire pair for repeater linking because of some inexplicable fear of hum and audio level problems associated with mixing audio and B+. Such problems are nonexistent, however, in most two-site links. The secret is in the use of "balanced" lines. The transformers themselves, placed at both terminal points of the line, serve to balance the dc by virtue of the choke action of the windings through which the dc must pass. The only suggestion here would be to use good transformers.

The secret of using only two wires for passing audio and carrier-operated-relay control signals lies in the use of the capacitor-transformer combination, which of course cannot pass dc. The dc is

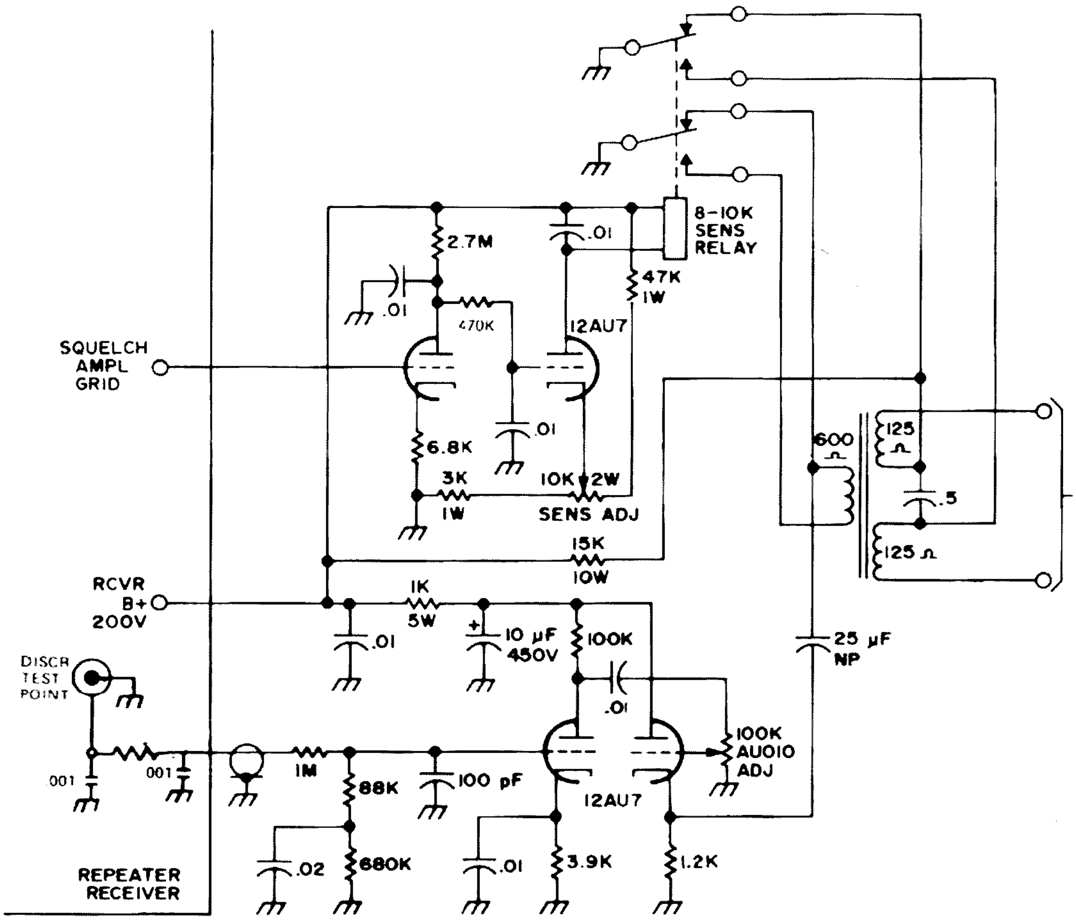

Fig. 3. Audio conditioning and carrier switching system. The audio transformer impedances are not critical, owing to the wide matching range of the cathode follower. The split secondary should match the primary of the transmitter-site transformer, however. The 100 kΩ pot in the cathode follower should be an audio type for smooth setting, though a linear taper will do the job.

imposed with the audio on the wire pair at the source. Then, at the transmitter site, the dc is directly coupled to the control relay while the ac is separated from the line by coupling it through an audio transformer.

At the receiver location, the audio signal is fed continuously into the wireline transformer (see Fig. 1), but the receiver squelch keeps audio off the line until a carrier appears. The carrier-operated relay on the receiver is used to apply B+ (dc control voltage) onto the wireline at the appearance of a signal, and to hold the line to a ground potential at all other times.

At the transmitter location, the two-wire line is connected to another audio transformer (see Fig. 2). The dc control voltage is used to key a sensitive relay (10 mA or so), which keys the push-to-talk circuit of the transmitter. This second transformer decouples the receive audio and feeds the transmitter mike circuit.

It would be a bad design to send pure B+ down the wire pair without some form of current-limiting. Without some form of current control, the wire pair would offer a dangerous shock hazard in the event of exposed insulation somewhere along the line; in addition, a short circuit could mean blown fuses or, conceivably, a fire hazard. Although the resistor shown in the circuit of Fig. 1 does accomplish another function, its key purpose to limiting the line current. The resistor value should be so chosen that it allows no more current to pass than 150% of that amount required to key the control relay at the transmitter site (Fig. 2). Once the relay has been selected, the resistor value can be determined by practical application of Ohm's Law. the transmitter. This second transformer decouples the receive audio and feeds the transmitter mike circuit.

For the benefit of the repeater builder who doesn't like to skip back and forth through a book to pick up bits and pieces of circuitry, Fig. 3 shows a complete receiver-site control scheme, which includes cathode follower audio processing, a carrier-operated relay, and a line transformer. All grounds shown are to the receiver chassis. . . .K6MVH

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The Art of T-hunting

There are many ways to have hidden transmitter hunts, but at California Polytechnic College (Cal Poly) in Pomona we have decided to remain on 6m and have minimum-time hunts. We have tried minimum-mileage hunts, but these have not gone over as well.

Most members have recently gone from using the directionality of the car's quarter-wave whip to loop antennas. Some use both modes, using the whip until they get close, then the loop for closing in.

Cal Poly has been having these hunts every other Friday since 1963 and these have been the most consistently popular events our club has. Although every area police department knows about us we have never had any real problems, just calls by neighbors or hillside dwellers who didn't know what we were doing. If the police arrive, we usually hear "Oh, you again!" And they ask us to keep it cool, quiet down, etc.

The basic system behind our T-hunts is a standard map. We all use the same map with the same borders for the eight sections. This cuts down on lost members and gray areas at the edge of a section.

The size of the area will depend on the terrain and the band used for the hunts. The maximum size should be an area slightly smaller than the effective communications range for that band under bad conditions. This makes the hunts more popular because people with poor receivers can still compete, yet it is usually a large enough area to make an interesting hunt.

To start the hunts the hidden transmitter usually goes directly to hide and does not meet at the beginning spot. The hidden transmitter should be able to be heard at the meeting point so that members can tell for sure that he is on the air. All hunters must meet at the starting point so that a car count can be taken and as the evening progresses they can tell who's left.

About an hour after the hunt begins clues should be given out. Small ones at first, leading to bigger and bigger clues until the hunt is called or all hunters are in.

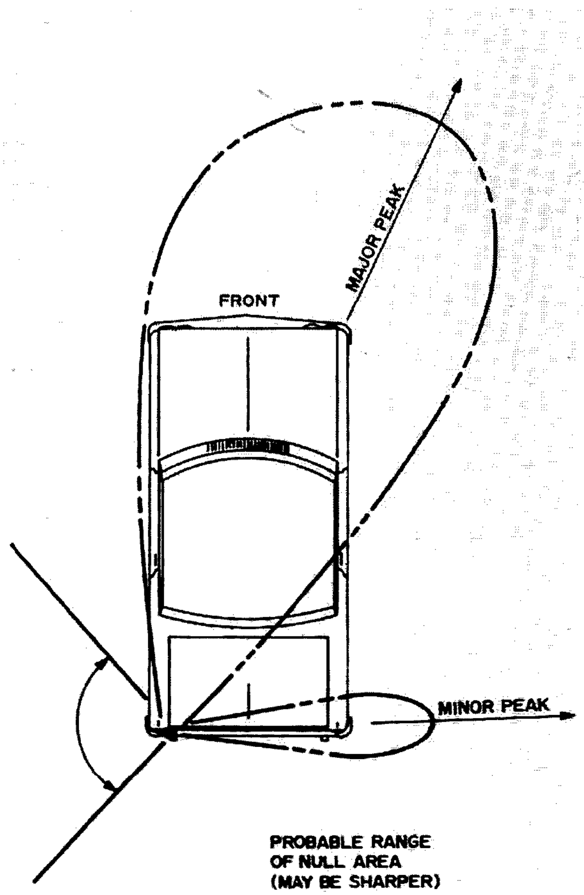

Fig. 1. Directionality of ordinary bumper mount whip.

It is a good policy to have 2m FM or some sort of guard channel to monitor during the hunt. Sometimes members will see or have accidents. Without a guard channel it could be a long time until someone gets through.

T-Hunting Techniques

If a car has an antenna mounted almost anywhere except the center of the roof it will have some sort of directional pattern. It is possible to use the car's regular radio antenna or even a gutter clamp type of antenna, but the best pattern seems to come from a bumper mount antenna.

The basic principle of this type of hunting is to box the hidden transmitter in. Start near a corner of the area where the signal is fairly readable, make a loop with the car and try to get a general direction. If no direction is apparent, just start driving; if the signal gets weaker you are going the wrong way.

Continue this pattern and keep boxing in the area where the transmitter is. Use the map if necessary to keep tabs on the directions and signal strength.

This system is good for both beginners and experienced alike. It requires only a converter and car radio for a minimum and the car's ignition noise can provide a suitable S-meter.

If the receiver you are using does not have an rf gain control it will be best to have a receiving type of signal attenuator connected between the antenna and converter or radio. As the signal gets stronger very little dip will be noticed but the attenuator will cut some of the signal out and not alter the pattern.

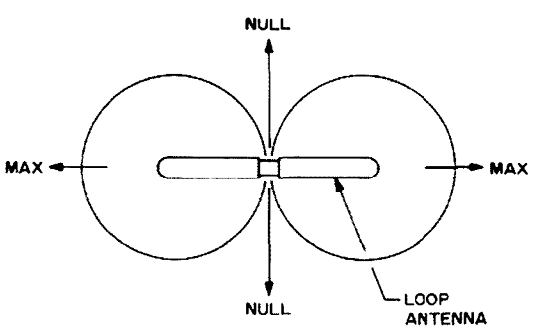

Fig. 2. Directional pattern of the coax loop.

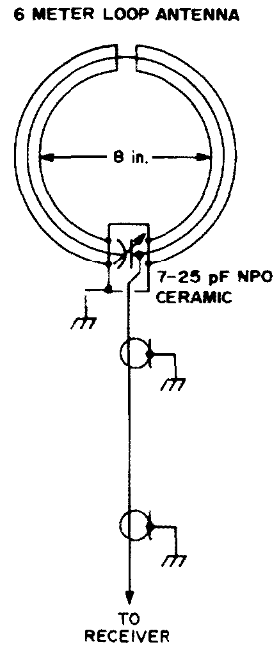

Fig. 3. Coax DF loop construction.

The shielded loop is far superior to the car body for directional characteristics, but is generally not as sensitive. Most of our shielded loops are simple RG-8/U coax loops about 8 in. in diameter. An insulated capacitor connects across the break at the support bracket, and the feed coax connects to one side of the capacitor.

The loop is tuned by holding a grid dip meter near the break in the shield at the top of the loop and adjusting the capacitor. Tune the capacitor for maximum dip at the operating frequency. If the loop will not dip within the band add or subtract capacity to lower or raise the loop's frequency.

The hunting technique is very similar to the car body hunting technique except that the rider can tell exactly what direction the signals are coming from at all times. If the loop cannot hear the hidden transmitter the hunters may have to use a car body antenna to get a strong signal, then switch to the loop antenna. Just remember that a loop nulls equally well in both directions. Don't let the hidden transmitter get behind you while you hunt for him ahead of you.

To check out either of the systems it is best to stage a dummy hunt. Use a grid dip meter, low power transmitter, or almost anything to get a weak signal on the band.

Make loops with the car, and check for

multiple dips or peaks. It depends on the car and position of the antenna where the nulls and peaks are located. Use whatever is clearest to follow as your hunting method.

For loop antennas get away from the signal so that the only signal received is through the loop and not from the wires to the loop. Check that the null is directly broadside to the loop and that it nulls equally well in both directions. If there is more metal directly on one side of the loop than the other the nulls may not be equally deep. This may be a help to establish the direction of the hidden transmitter if the hunter becomes confused. Also as the hunter approaches the hidden transmitter he will notice that the corrections to keep the signal nulled out will become sooner and sooner.

Some receivers may tend to overload as the signal strength becomes very strong. Often the only way to come in for the last quarter-mile is to pull the antenna from the radio and follow the signal strength.

Using any of the systems it is very important to have a rider along – someone to read maps, S-meters, and in general allow the driver to do what he is supposed to do: *drive*. It is not only dangerous and foolhardy to hunt alone, but less interesting.

Past Hunt Experiences

Every new hunt is an experience but in the past there have been several hunts which are classics for our group.

One of the most famous has been the quarter-mile wire hunt. On this hunt a member attached one end of a very large roll of wire to a light post and rode up a nearby hill on his trail motorcycle with the roll of wire on the back of the cycle.

His truck was then driven to the top of the hill and the wire was loaded on 6m. The antenna created many "hot spots," places where there *appears* to be a strong source of radiation. Even after people were able to find the true antenna's location the signal pattern was such that when they got directly under or near the end of the wire the signal would disappear.

Directionality is very good for confusing hidden transmitter hunters. Portable beams such as a take-apart yagi or quad work very well. If you know the receiving directional pattern of the car it is also the same for transmitting. If there are many roads leading into an area but only one way to get to the site, beam the signal away from the real entrance or rotate the antenna so that the pattern shifts constantly.

There are other ways of disguising the hidden transmitter's location. An unorthodox method is to use multiple hidden transmitters all running on the same frequency. If the transmitters have about equal signal strength they can create havoc for the most experienced of hunters. This method is suitable for large ham parties or club outings that can be prepared long in advance. The signals may even be identical if a second frequency is used to transmit the audio portion of the signal.

The more conventional way is to change vehicles or park in very obvious locations.

A change to a completely unknown vehicle and the use of an external antenna has been very successful in the past. On a recent hunt the hidden transmitter was located in a late model Lincoln Continental parked in a typical "date" type parking spot nearly overlooking the Cal Poly campus. It was a very easy hunt to get into the general area, but not after that. Most people will respect the couple in a parked car and not knock on the windows or use flashlights etc. The hidden transmitter was located by the coax leading out of a rear car door, but not until after almost twenty minutes of frantic looking.

Jack Stone (WA6BHJ) and his portable quad.

The obvious location is effective because no one would suspect anyone of parking there. A movie theatre parking lot, shopping center, residential neighborhood, almost any easily accessible place that has many other cars is excellent.

T-hunting is a great method of having fun and is as cheap or as expensive as the hunters want it to be. People have hunted successfully with as little as a Heath lunchbox and the car radio antenna, a converter to the broadcast radio and using the car antenna, or on the other extreme Swan 350s and Collins S-line with FET converters and loop antennas.

Many thanks to the members of the Cal Poly Amateur Radio Association and especially WB6AEJ, WB6HHM, WB6MYZ, WB6NUV, WB6PQV, and WB6ZJC for their contributions over the years to the club's hunting experience and their experience with T-hunting.

WB6IQS

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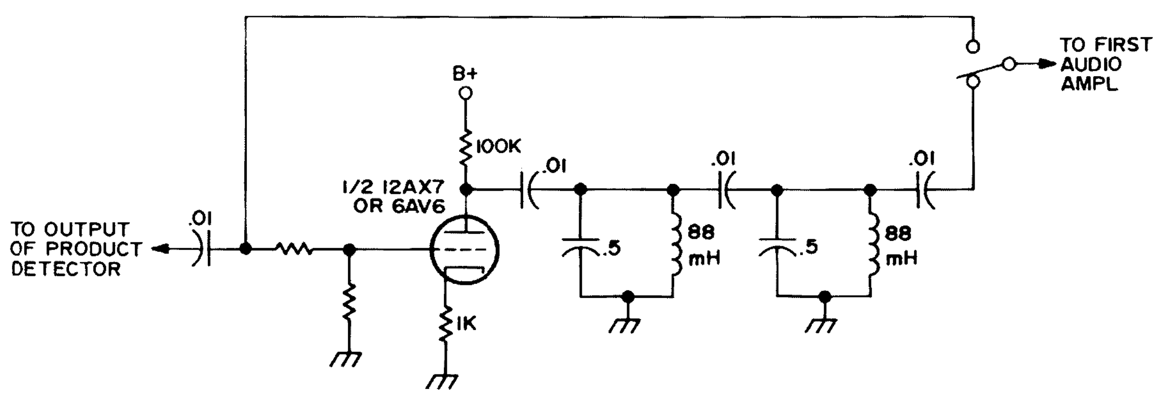
An Ultra-Simple Selective Audio Filter

There have been several articles in various amateur journals showing how to use the now commonplace (and cheap) 88 mH toroids to make highly selective audio filters, ideal for CW reception. Unfortunately, most of these articles have made a major project out of something that's really quite simple. In such a device, all that's necessary, other than the components comprising the filter itself, is a modest stage of audio amplification to equalize the gain when the filter is switched in. Most of the devices described to date have been designed to plug into the receiver's phone jack, and contain amplification to drive headphones. Besides duplicating circuitry that you already have in your receiver, this is wasteful of power, as two audio stages are required instead of one.

Besides, if you're like me, you hate to have a lot of outboard adapters and the necessary cables hanging out of your receiver. Nothing can make a station look junky and unprofessional as fast as a whole bunch of little boxes strung out over the operating table. I build everything in. If you don't want to modify your receiver, it's very easy to bend up a little L-shaped chassis which can be mounted inside a receiver on the back or side of the cabinet. Of course, if you're really cramped for space, it could be mounted outside the cabinet on the back.

This simple audio filter is highly flexible and can easily be squeezed into even the most compact receiver. If you have gain to spare, you may want to dispense with the input amplifier altogether. Most receivers will require it, and it can be built around half of a 12AX7, a 6AV6, or an audio FET without altering the circuitry shown. The



The two resistors in the input voltage divider should total approximately 1 MΩ. They should be adjusted for a balance between audio levels with the filter in and out. For a tube version, anywhere from 100 to 300V is fine. If you use an audio FET, select your voltage according to the manufacturer's recommendations.

use of a bipolar transistor is not recommended – the low impedance of a bipolar device will load the audio output of the product detector so much that the gain of the amplifier will be canceled. Whatever you use for an amplifier, power requirements are negligible.

In construction, no particular precautions need be observed except to adequately shield the audio leads. The voltage divider ahead of the input amp can be a 1 MΩ pot, but for the sake of compactness, using a couple of fixed resistors to balance the gain is preferable. The values of capacitance in the filter yield a center frequency of about 750 Hz. If you prefer a lower note, increase them (and vice versa).

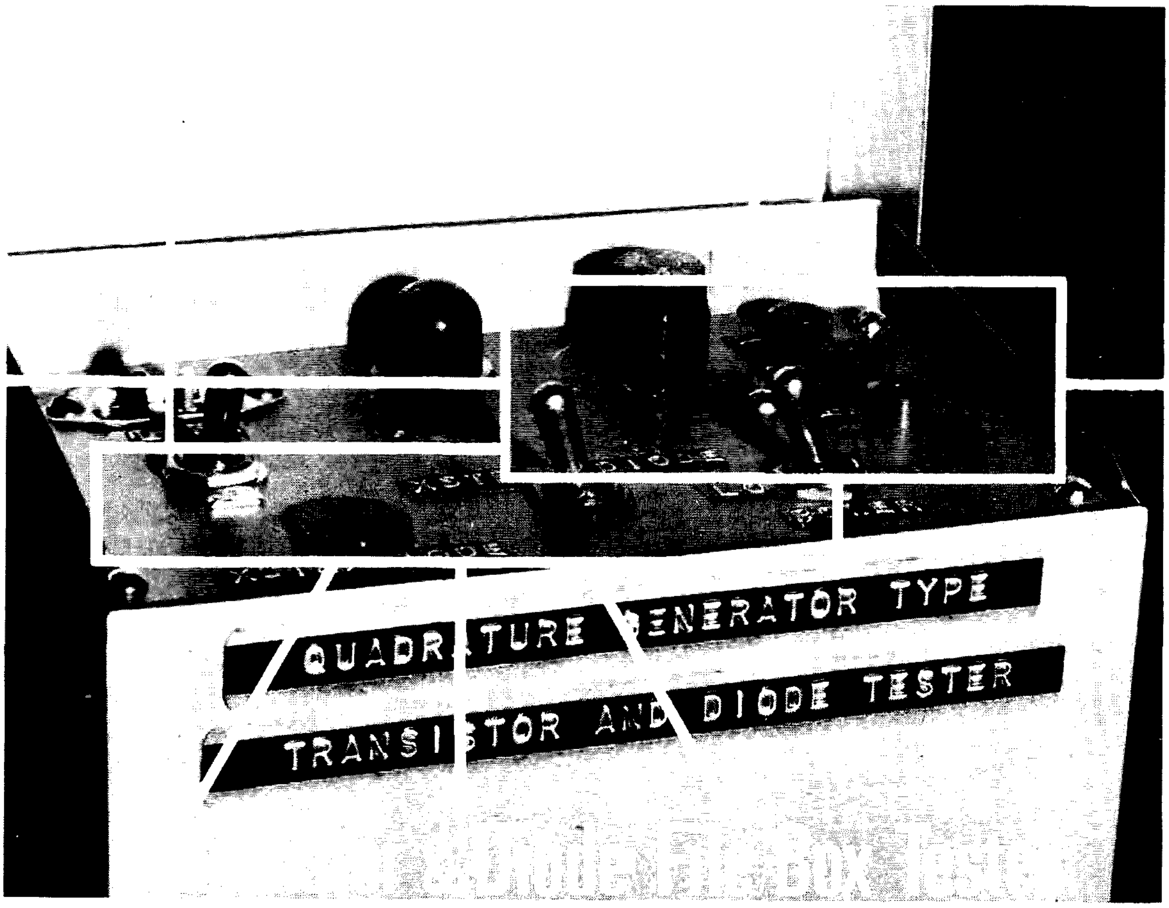
Bandwidth is about 75 Hz at –6 dB, 100 Hz at –20 dB, and 250 Hz at –40 dB. When this high selectivity is employed with some kind of i-f notch filter, you can sort out even the wildest pileups with ease. If your receiver doesn't tune pretty slow, you'll probably find it difficult to avoid passing right over signals. If this is your problem, a simple vernier adapter will solve it.

This is strictly a "no-sweat" project. Nothing is critical, it can be built in just a few minutes, and it probably won't cost more than a couple of dollars. However, the results are most gratifying, and it sure beats laying out $50 or more for a 100 Hz crystal lattice filter!

In using the filter, you'll find that white noise and static crashes are greatly reduced, but in the presence of pulse noise, this unit, like all other highly selective devices, is subject to severe "ringing." The use of a good i-f noise blanker is almost mandatory, if full benefit is to be derived from the filter. This circuit is ideal for the CW man, and should prove to be just the thing for those interested in moonbounce work.

Incidentally, with this filter in, you'll find out how stable your receiver really is. You may be surprised! By zero-beating with an accurately calibrated audio generator, it's possible to make highly accurate measurements of drift in your receiver, or on that vfo you're building, using this filter.

. . .W8RHR■



In conjunction with an oscilloscope, this file box tester will allow you to check visually the condition of a number of diode and transistor types. The parts list is relatively small and the cost is nominal, the largest item being the 26V transformer. It is simple to build and fascinating to operate.

The circuit is based on furnishing two voltages, phased 90 degrees apart, and connected to the horizontal and vertical scope stages. The base of the transistor under test is connected to ground, the emitter and collector to the respective plates.

Referring to Fig. 1, we see the usual power line connections to the transformer primary. The 26V transformer secondary is supplied to two simple phasing circuits which, when connected to the scope vertical and horizontal amplifiers, results in a circle on the scope screen.

Note that, to exhibit a perfect circle on the scope screen, both vertical and horizontal amplifiers must be adjusted to an equal deflection on the scope and they must deflect linearly. In fact, the attempt to adjust for a perfect circle is a good test of deflection linearity. If the circle has a "flat" on the right side of the circle, the horizontal amplifier is nonlinear. If there is a flattened portion on the upper side of the

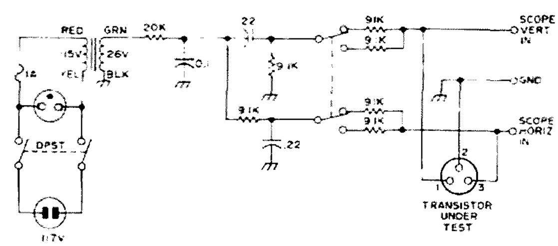


Fig. 1. File box line-quadrature generator type transistor and SCR tester.

circle, there is nonlinearity in the vertical amplifier. Fortunately, some nonlinearity will cause little test result degradation.

The term "quadrature" denotes the finding in square measure of the area of a bounded surface, as of a circle. It also has a meaning of the division of a circular area into four equal sections.

Figure 2 illustrates some of the various possible scope patterns. Note that a good PNP transistor will show a pattern of a quarter "pie" or a quadrant in the lower left portion of the scope screen. A good NPN transistor will show in the upper right quadrant of the scope screen. A good SCR will show a half circle, a unijunction an oval, and a good diode will result in a tilted half circle.

Now, if the collector and the base of a transistor are shorted, only a vertical line will result. If the short is between emitter and base, the pattern is a single horizontal line. Note that the lines radiate from the pattern center.

If the short is between emitter and collector, the single line will radiate on an angle, depending upon whether the transistor is NPN or PNP. A simultaneous short between three transistor elements will show a dot on the scope screen.

Let us suppose that the transistor is neither good nor shorted, but leaky. In this case, the pattern will look like a good transistor except that one leg will be foreshortened (base to collector, base to emitter).

The final group of patterns shows what happens when one of the elements is open. These result in a semicircle covering two of the four quadrants. Basically, what you have left is a diode.

Also included in the scope patterns are the SCRs, unijunctions, and simple diodes. The quadrature generator could also be used for the evaluation of other solid-state devices, but those given in this article should be sufficient to act as a base for additional solid-state types.

A switch allows limiting resistors of 9.1 or 91 kΩ to be inserted in the circuit. For most tests the "low power" position should be used.

Assembly

To assemble the unit, first drill four #25 holes in the bottom of the file box, positioning each 0.5 in. from a corner. Mount the four feet. Drill and mount the two angles for the panel mounting. Position them about 1/8 in. down from the front lip of the box, and at each end of the box. Fasten them with 6-32 screws. After drilling the four mounting holes in the panel, drop the panel onto the brackets and spot the four holes on the brackets. Drill and tap for a 6-32 screw.

The box is now finished except for drawing the schematic on a 3 x 5 file card and pasting on the bottom of the box. A larger 4 x 6 file card could be pasted in the inside lid to show the various patterns as illustrated in Fig. 2.

Now, finish drilling the panel holes. A word of caution: Never take hole diameters from an article. Always check your individual parts, because they sometimes differ. The TV type connector socket hole can be made with a "nibbler," or a series of holes drilled and then filed oblong. Don't forget to mount the insulated washers between the panel and the nuts of the banana jacks. Incidentally, the hole for the banana jack is the diameter of the shoulder of the shoulder washer. The two holes for the transformer depend upon the transformer used. Check these. Mount and wire the parts. You may prefer to mount the resistors and capacitors on tie lugs. Two 5-lug units will suffice. The tie lugs can be mounted through the same screws as used for the transformer. The switch marked XSTR-DIODE, as shown in the picture has been removed from the circuit as unnecessary.

The 3-hole socket is used so that several sockets can be plugged in. These could include a regular transistor socket, a diode socket, a socket for a power trasnsitor, etc. It was felt that this gave the unit a much greater utility and lessened its obsolescence possibility.

Operation is simple. Connect the unit to the house voltage. Turn the switch on. Connect banana plug leads to the scope's vertical and horizontal inputs as well as to

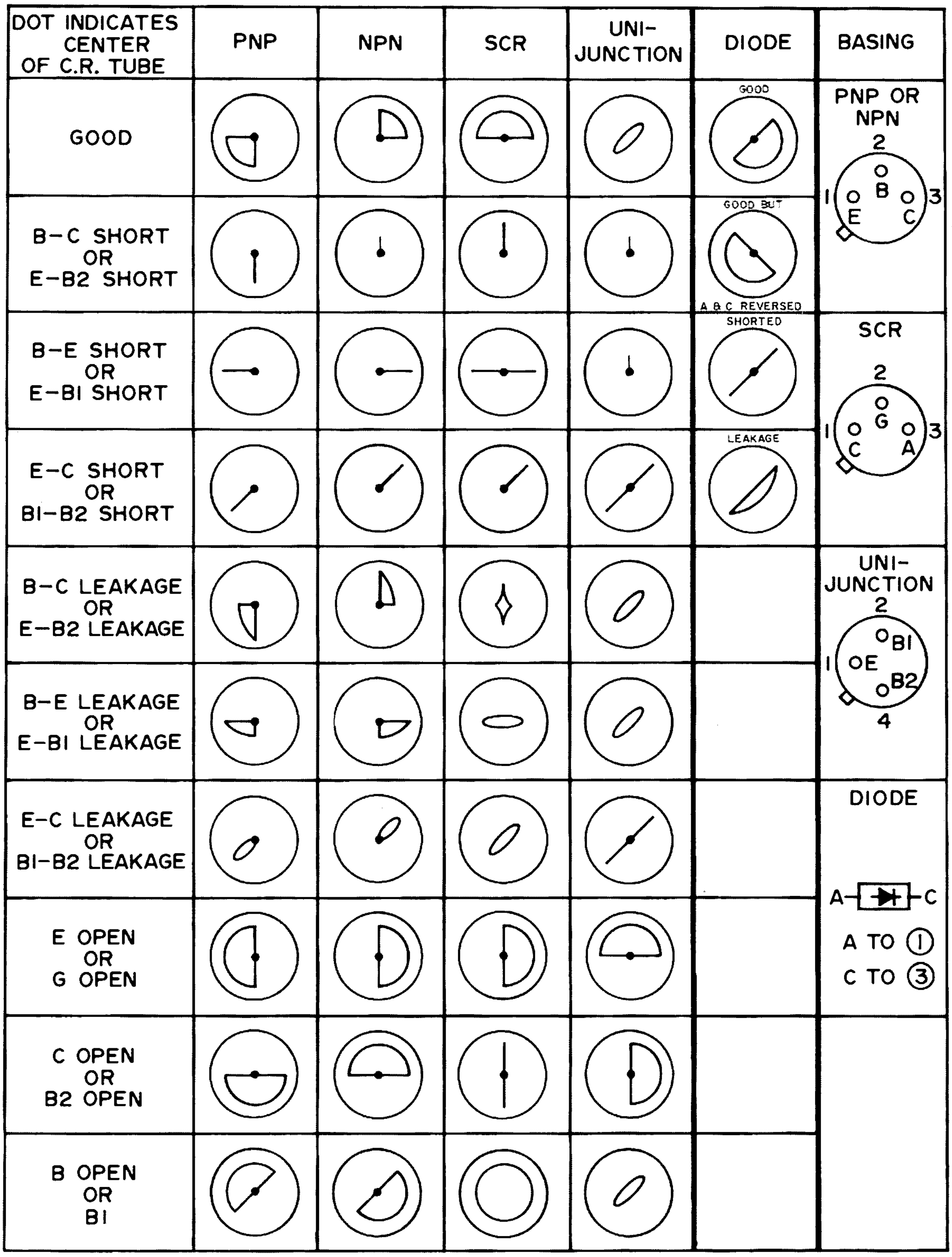
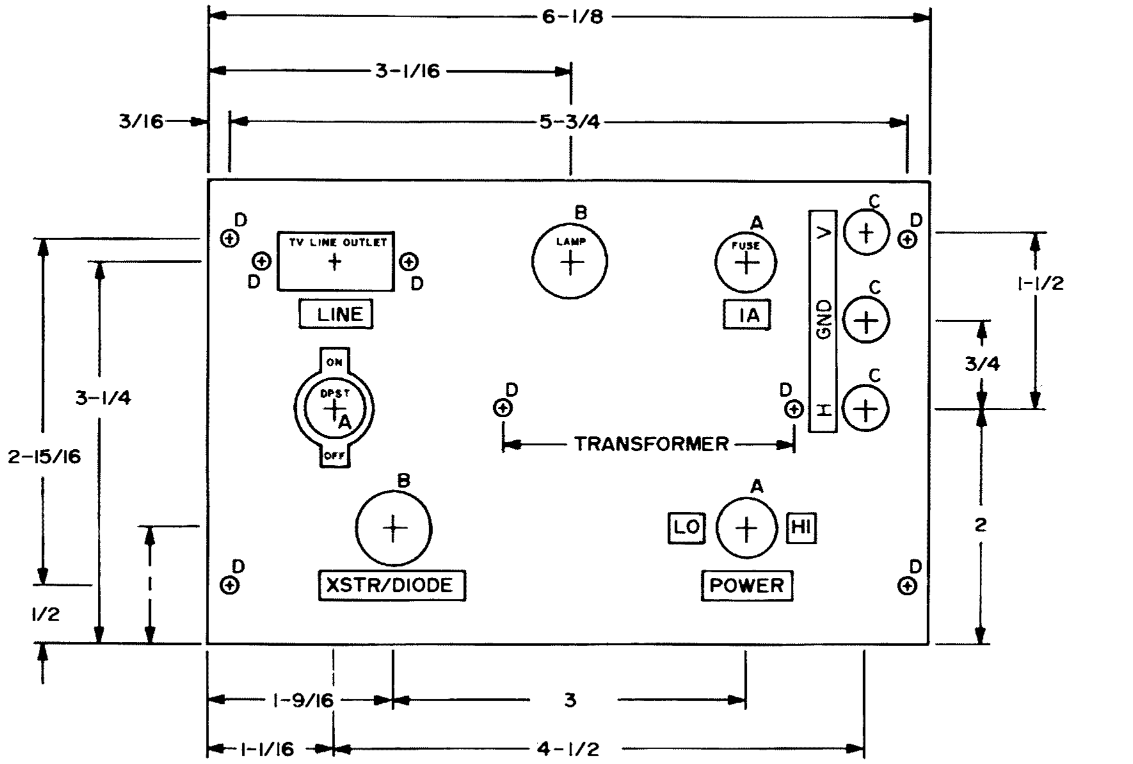


Fig. 2. Quadrature generator transistor and diode tester file box.



HOLE CHART		
LTR	SIZE	QTY
A	1/2	3
B	5/8	2
C	3/8	3
D	NO. 25	8

Fig. 3. File box line-quadrature generator tester panel.

scope ground. Adjust the scope for a circular pattern. Plug the transistor into the XSTR/DIODE socket. Be sure that it is connected correctly. Note the pattern on the screen and refer to the various patterns for interpretation of the pattern. Except for power transistors, the LO-HI power switch can be kept in the LO position.

There is no question but that this tester will show the condition of a transistor better, because it shows, for instance, leakage as a quantitative element. You can see just how much leakage an individual transistor has. By first connecting a good transistor in the tester and then paralleling base to emitter, or base to collector, with a very high resistance resistor, then a lower value, you can see the one side of the pattern begin to foreshorten. I haven't tried it yet, but I'm going to try using the unit for testing ICs. Of course, some will not be testable, but if you take it circuit-for-circuit, you should be able to test the individual IC elements of many devices.

List of Unmarked Parts

(1) Fuseholder & 1A 3AG fuse.
(3) Jack, banana - (2 red, 1 blk.)
(1) Miniature socket (Amphenol series 78-3S) 3-hole
(1) Miniature plug (Amphenol Series 71-3SO) 3-prong
(1) Neon indicator - 115V with built-in series resistor
(1) Power transformer (UTC FT-14 or equiv.) Pri 117/Sec 26V
(1) Switch, toggle, dpdt.
(1) Switch, toggle, dpst.
(1) Socket, TV type & mating plug.
(1) File Box, metal 6 1/4 x 4 1/2 x 4 (Ohio Art).
(2) Bracket, angle aluminum - 4 x 1/2 x 1/2 in. (Reynolds Metal #2406 or equiv.)
(4) Rubber feet with 6-32 mounting screws and nuts.
(2) Tie lugs, 5-position.

. . .WB4ITN■

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Crystal Tester

Here is an easy-to-build crystal tester to tell you at a glance whether or not a crystal is capable of oscillation. Battery operated and inexpensive to construct, the tester will find use in weeding out those questionable crystals that have been accumulating in the shack for years. The tester is actually small enough to carry along with you when you buy surplus crystals at the local emporium.

To use the tester, simply insert the crystal to be tested into one of the crystal sockets and press the test switch. If the indicator lamp glows, the crystal is good. If the lamp does not glow, the crystal is bad . . . what could be simpler?

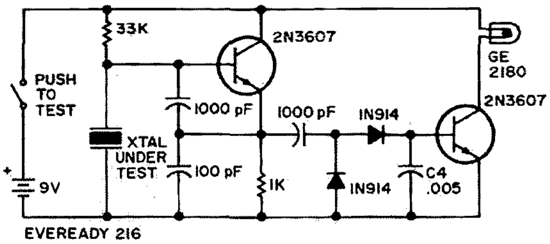


Fig. 1. Crystal Tester Schematic

The tester checks for oscillations but does not check that the crystal is oscillating at its marked frequency. Crystals that fail the test inevitably are found to be fractured, to have dirty contacts or broken leads. The tester has been used successfully to check crystals ranging from 3.5 MHz to 90 MHz.

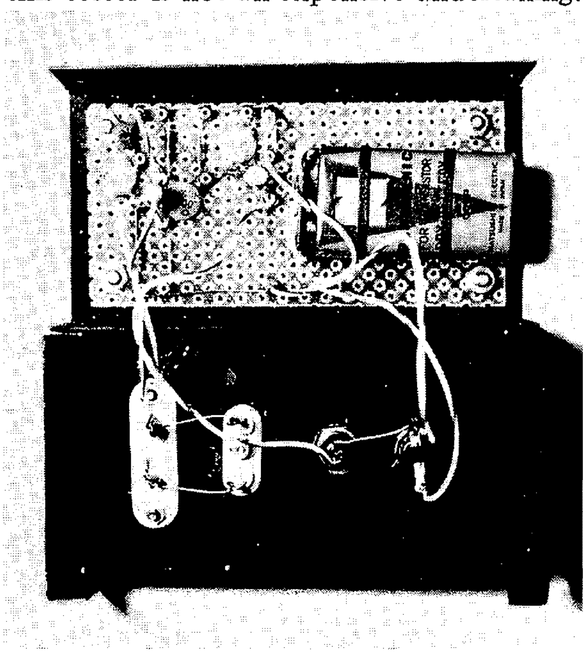
Figure 1 shows the schematic of the tester. The circuit portion at left forms an untuned Colpitts crystal oscillator which is able to oscillate over a wide range of crystal frequencies. (Of course, the absence of tuned circuits to reject harmonics means the oscillator output will not be a pure sinusoidal pattern, but this is of no concern in the present application.)

With a good crystal in the circuit and the test switch closed, the circuit will oscillate and several volts peak-to-peak will be developed across the resistor in the output of the first stage. This peak-to-peak voltage produces a dc bias at the base of the output transistor and thus causes the indicator lamp to glow.

If the crystal under test is bad (i.e. fails to oscillate) no signal will pass through the coupling capacitor and no bias will be developed at the base of the output transistor. Thus, the indicator lamp remains off, indicating a bad crystal.

The photographs show the general appearance of the tester and the method of construction. Components are mounted on a 1¾ x 3¾ in. piece of Vector board which is mounted on 1/8 in. standoffs from the bottom of a 4¼ x 2¼ x 1½ in. Minibox (BUD CU-3016A). Crystal sockets suitable for FT-243 and HC-6/U were mounted on the lid of the Minibox and wired in parallel to accommodate the most common types of crystal holders. A miniature SPST push switch (SI) and the indicator lamp were also mounted on the lid of the Minibox.

Neither circuit layout nor component values are critical. The active components should be computer switching devices, although the output transistor can be any NPN capable of collector currents in the 50–100 mA range, as determined by the indicator lamp. All components shown in Fig. 1 could be purchased new for a total cost of under $4.00, so the construction of this tester is not an expensive undertaking.



– Method of construction, Minibox opened up –

While I used a 9V transistor radio battery in the tester, any battery voltage from 6V to 15V could be used. The tester draws current only when the push switch is closed; thus, if tests are kept short, battery life will be quite long. The original crystal tester has been used to check perhaps 50 crystals over a two-year period and the original battery is still going strong!

. . .K6VCI■

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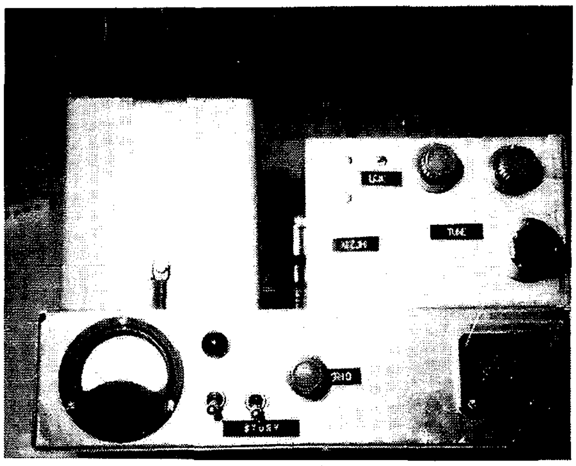
A Compact Kilowatt for Six Meters

Desiring to join the ever growing number of stations on 6m sideband, I finally built a transverter for my HF station. After a few evenings of operation, it became obvious that the 5W output from the transverter was not going to lead me down any great road to fame or glory. Not to be outdone by the average 300W signal, I decided it was time to join the elite and get at least 1 kW on the air. A quick look at my financial resources and the price of commercially available linears was enough to make me get out the drawing board and handbooks.

The linear was built as small as physically possible. Its 8 x 11 x 3 in. chassis houses the complete linear – power supply and all. One reason for the small size of this truly compact kilowatt can be attributed to the use of a 4CX250. Besides enabling the construction of such a small device, the 4CX250 has several other advantages which made it a logical choice. The tube is rugged, and it is available to amateurs at reasonable prices. The 4CX250 was designed for VHF, and it is also a zero drive tube when used in class AB1. This makes it ideally suited for use with exciters with low power output. The only power required of the exciter is to overcome circuit losses between the exciter output and the control grid of the 4CX250. If 4CX250s are not readily available, 4CX150As (7034s) may be directly interchanged with no change in the linear's construction or operation.



The linear requires a large blower. The 4CX family of tubes is well known for the ability to handle a good amount of power. If you wonder how these tubes handle the large amount of heat dissipated in class AB1 operation, the answer lies in the circular air fin arrangement surrounding the anode. Air must be force-fed through. The more air, the cooler the tube and the longer its life. The minimum airflow permissible is 6 cfm through the fins. A 100 cfm squirrel cage may move a lot of air in free space, but when you get it feeding into a pressurized chassis, you will be lucky to get the required airflow through the plate fins. Be sure to use a chimney with the sockets. Also be sure to use a socket with a built-in screen bypass capacitor.

One of the few drawbacks of the 4CX250 is its requirement for filament voltage. Unlike most commonly used transmitting tubes which are perfectly happy with 6.3V or something thereabouts, the 4CX250 has a *maximum* filament rating of 6.0V. You may wonder what difference 0.3V can make, but it is very important. The 4CX250 is subject to cathode back bombardment and the condition worsens with frequency. The manufacturers recommend decreasing the filament voltage at UHF. The condition is minimal on 6m, so any voltage between 6.0 and 5.9V should prove satisfactory.

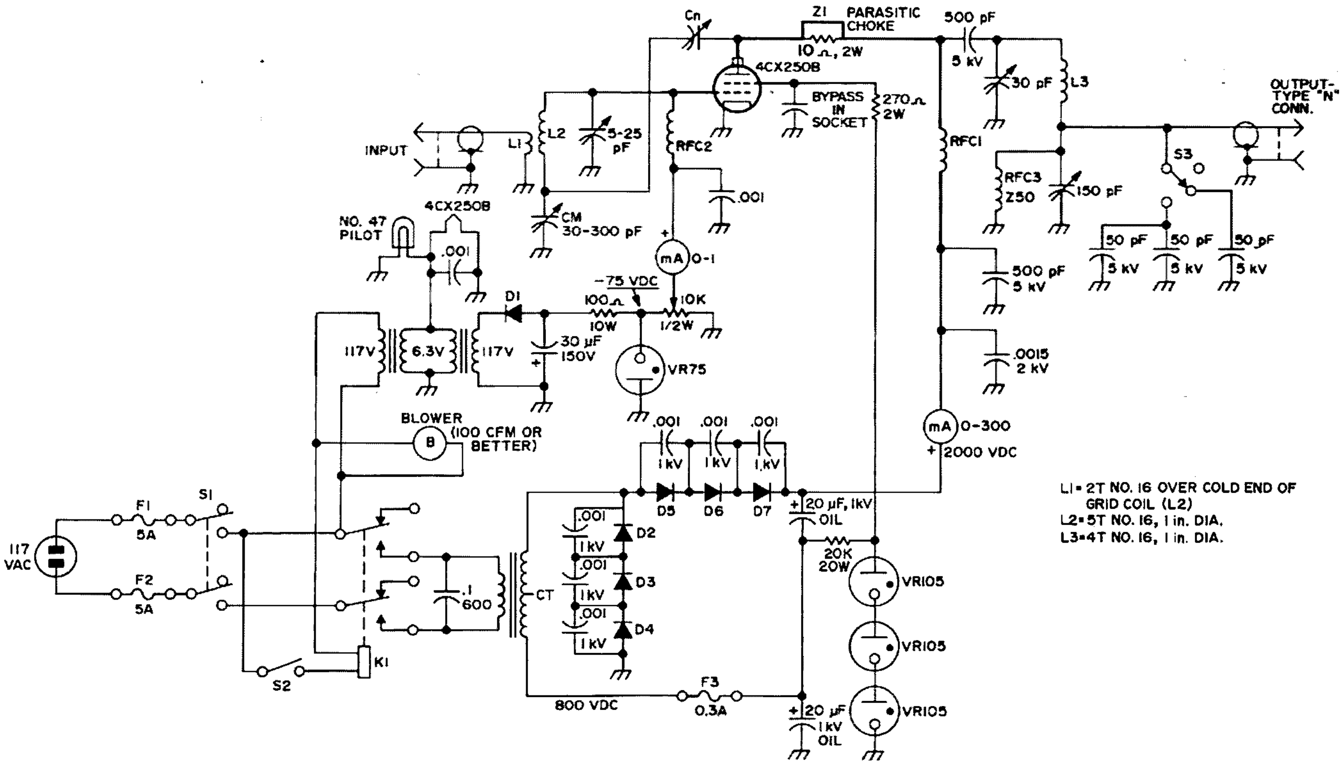


Fig. 1. Schematic of compact kilowatt. Unmarked capacitors should have 1 kV rating.

Schematic Parts List

T1 – 117V ac to 6V ac filament transformer, 2A sec.	D1 – rectifier
T2 – 117V ac to 6V ac filament transformer. 1A sec.	D2–D& – Silicons, IA at 1000 PIV
T3 – 117V ac to 800–900V ac at 300 mA or better	CM – About 30–300 pF compression mica trimmer
SW1 – 10A 2PDT switch	CN – Metal plate, see text; diagram
SW2 – 1A SPDT switch	RFC2 – 20 turns, No. 18 enamel, ¼ in. D.
RY1 – 117V ac relay 10A contacts	RFC1 – No. 24 to 20 wire wound over ½ in. d. ceramic form for 2 in. to 2¼ in. of length
	SW3 – Ceramic 3 position single pole

The rest of the power supply is for bias and plate and screen voltage. The bias transformer is a filament transformer with its 6.3V winding connected to the 6V filament supply. This produces around 110V on the other winding which is rectified by a half-wave rectifier and then regulated by a VR-75 gas regulator tube. This then goes to a variable voltage divider which supplies the bias to the 4CX250 grid. The transformer used for the plate can be obtained from an old scrapped TV set, providing it delivers around 900V across the full secondary winding. Most of the transformers used in older sets were heavy brutes and work well in linear service. The transformer feeds a full-wave voltage doubler. The screen is fed from the 2100V supply by a large dropping resistor and is regulated at a constant 300V by three VR-105s. The small resistor across each VR-105 provides equal firing potential when the supply is turned on. The screen and plate voltages in a linear should remain fairly constant; while the plate voltage can swing slightly, the screen supply is critical and should be held as stable as possible. This rules out the use of a voltage divider using resistors or, even worse, a simple dropping resistor.

The current drawn by the screen supply and the idling plate current is beneficial when used with a voltage doubler. This type of supply is characterized by a rapid rise in voltage with no load. The regulation is good; my voltage is 2100V idling; at 550W dc input it drops to around 1900V.

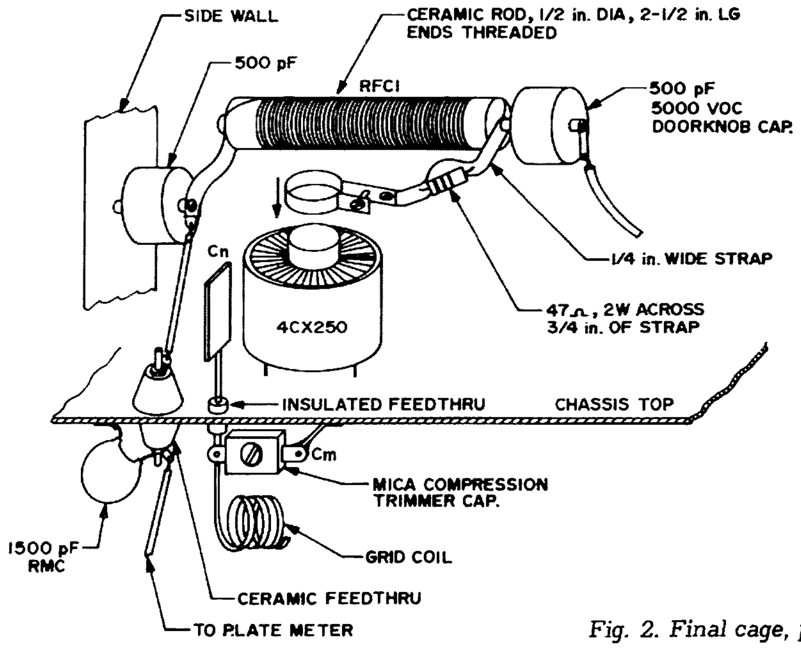
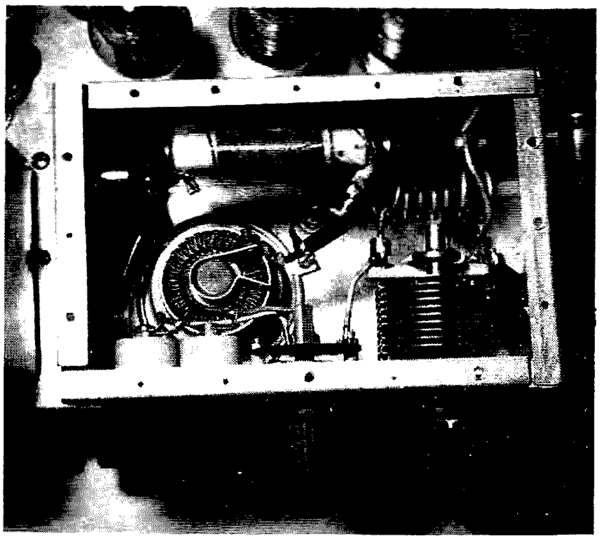


Fig. 2. Final cage, partial view.

If you stray from my power supply design and incorporate a separate supply for the screen, be sure that it is not possible to apply screen voltage without plate voltage or the tube will be damaged.

The use of a plate current meter and a control grid current meter is necessary for proper operation of the linear. It is true that in AB1 no grid current is drawn, and the reason for the grid meter is to make sure you keep operating that way. A screen current meter is recommended since you should be sure not to exceed the screen's dissipation ratings. I skimped on this since I've found the 4CX250's screen current generally stays well within bounds when run at high plate voltages. If you should decide to install a screen meter, a zero center meter should be used, or else you will have to provide a reversing switch. It is possible for the tube to exhibit a negative screen current at times. While it is not something to worry about, it usually indicates overloading. The screen current should be kept under 20 mA.



The stability of the linear is excellent. I have always been a firm believer that neutralization is unnecessary with a properly designed and built amplifier. Most other tubes I've used responded quite nicely to screen neutralization and I almost got away with it here, but the 4CX250 proved to be my match. Neutralization was found necessary to insure stable operation. The neutralization capacitor is a 1 in. square of silver-plated copper supported on a piece of 16-gage wire. The capacitor is located directly to the side of the 4CX250 anode and is away from the plate tank. This is important. It should also be directly above its destination below chassis, and for rigidity should be supported by a ceramic feedthrough. Neutralization is achieved by the setting of Cn and Cm. Be sure to use the recommended socket. The socket has a circular screen bypass capacitor built in and also pins 2, 4, 6, and 8 are grounded, which are all cathode pins. Ground all bypass capacitors to individual soldering lugs. This will avoid common ground paths

which may set up oscillation within the linear. No amount of neutralization will cure this problem.

The plate tank circuit is a pi-network type. The plate loading capacitor is capable of being shunted by several values of fixed capacitance. This gives quite a range in which to find the correct loading. The tuning and loading capacitors are mounted piggyback fashion in the final compartment. The tank is wound with 12-gage silver-plated wire. I tried using a Miniductor and the first time rf hit it I was rewarded with a blob of melted wire and burnt plastic. The conventional form of parasitic choke was tried. A 10Ω resistor with two turns of 16-gage wire lasted 10 seconds before it departed in a puff of smoke. The total amount of rf voltage across the wire in the choke was appreciable at this frequency and it quickly overheated the resistor. An inch-long copper strap across the 10Ω resistor finally worked quite well. The rf choke is wound on a ceramic form. The 24-gage wire should be given several coats of coil dope. The form is a ceramic rod about 3 in. long and ½ in. diameter. The ceramic form should have as much of the 24-gage wire wound on it as possible.

At first I was rather afraid to build such a small final compartment. Several things bothered me. Would the heat from the 4CX250 damage any of the components? Would the heat cause thermal expansion and detuning? Another thought which plagued me was what would happen with the tank coil placed close to the walls of the enclosure. I could see the Q of the coil being ruined and a few hundred watts of rf being inducted into the enclosure's walls. Luckily, none of my fears were realized and it worked like a charm.

Use of an rf-tight box for the final provides excellent isolation between the input and output. If TVI is a bad problem in your area, the use of meter shields is recommended. Also screen the blower air port and add additional power line filtering.

The clip for the 4CX250 plate is homemade. One word of caution. The parasitic choke is mechanically connected

to the plate clip with a 4-40 screw and nut and a very small amount of solder. The tube may be hot enough to melt solder, so avoid "solder held" connections. I had one tube overheat and the parasitic choke fell off and shorted the B+. In a 2m linear using a plate line, a 4CX150 got hot enough to melb a blob of solder off of the plate line. It dribbled through the plate fin and hit the screen bypass ring. If you are able to silver solder, by all means do so.

At my station the linear is connected between the transverter output and the antenna relay. This eliminates the need for a changeover relay. I also leave the linear's B+ on. It does not switch to standby in the receive position. This eliminates control cables and the necessity of another clicking relay every time I transmit. If you are not going to transmit for long periods of time, switch the linear to standby.

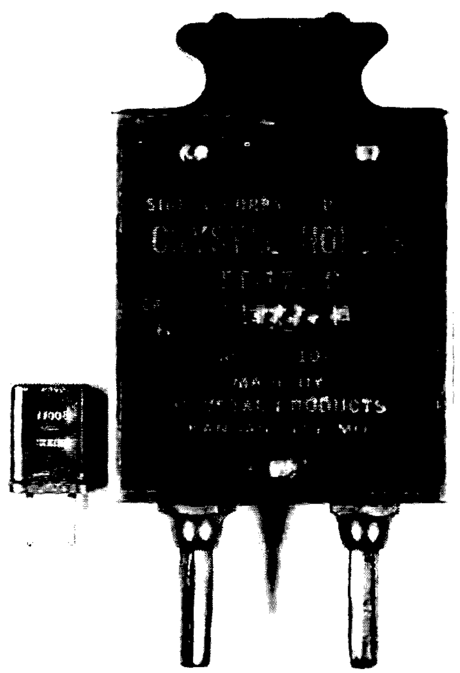
Before attempting to use the linear, it should be neutralized. There is enough information in any of the handbooks for you to do this on your own. For the smoke test, be sure the bias pot is wide open and that there is at least -60V on the grid. Turn on the B+ and adjust the bias for 78 mA of idling plate current. The bias voltage should be in the area of -40 to -50V. Apply drive and tune the grid for maximum plate current. With the loading capacitors set at maximum capacitance, dip the final. Increase the loading and alternately dip the final until you are drawing 300 mA. With the exciter in the SSB position you should be able to kick the meter up to 275 mA on voice peaks with no indication of grid current. The screen current should be 20 mA maximum. If you didn't use a screen meter, observe the VR105s. If they almost extinguish when you talk, this indicates the screen is drawing too much current. Recheck the tuning; a slight change in the load setting should correct this condition. It is important to load a linear for maximum output. This affects the plate impedance and the best match occurs at maximum loading.

I have used this linear for several months and the results have been better than I had hoped. Reports have all confirmed that the quality is good and the

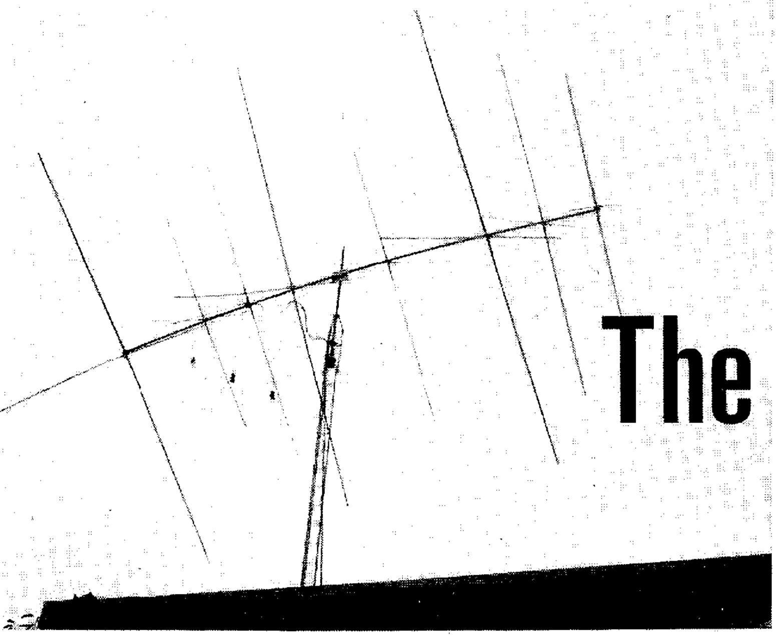
signal is penetrating. The linear of course can be used on CW and if the power supply will handle it, AM should be okay too.

With the new interest in meteor scatter, this linear should be a helpful companion to any low-power exciter, such as the Heath HX-30. Even the larger transceivers can be used if their output is swamped down enough to prevent overexcitation. With at least 500W dc input, and a theoretical 1 kW PEP, this linear performs as well as anything available.

As an afterthought, I can see no reason why two 4CX250s couldn't be paralleled for greater power,. ALC may be needed in some cases. I found it unnecessary since the ALC in my Marauder prevented overdriving of the transverter or linear. The small resistor across the input is to keep a load present on the input. This prevents self-oscillation when there is no load connected to the output or to the input. To sum it all up, the compact kilowatt is easy to construct and run. Its size makes it ideal for any 6m station contemplating higher power. . . .K1ZJH■



"Old timer, I get bad vibes from anyone over 30."



The 3-4-6 Quad

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As a result of some intriguing 10 meter openings and my inability to work through the QRM with my 3 element triband yagi, I decided to construct a single-band quad, sacrificing 15 and 20 through the winter for an all out effort on 10. I chose a 6-element array with a 30 ft boom, the longest length boom I could get away with in my particular neighborhood. While forward gain peaks at .13-wavelength element spacing[1], there is negligible loss (a fraction of a dB) in going to .18 wave, but the latter provides an increased front-to-back ratio, broader gain-bandwidth product and is the figure required to equally space 6 elements on a 30 ft boom on 10 meters!

The prime forward gain determinant for a beam antenna, whether a closed loop quad or a yagi, is the boom length. In general, the longer the boom the greater the gain of the array. The feature of the quad which makes it particularly desirable is its 2 dB gain over a yagi of the same boom length. For a given required gain, a quad need only be about 0.56 as long as its yagi counterpart[2]. This point is crucial for those who live in urban centers and are afflicted with a desire for DX. It is also a point for anyone who does not have a relative in the crane rental business.

After some additional thought about not having 15 and 20 I decided to lengthen and add spreaders to restore my triband capacility. The result is the arrangement of Fig. 1. The configuration is such that there are 6 elements operating on 10 meters, 4 on 15, and 3 elements on 20. Each element is spaced .18 wavelength from its same band neighbor.The gain lost on 15 and 20 by not utilizing the entire boom through decreased spacing and additional elements is negligible considering the boom lengths used. In addition, this spacing affords economy in spreader construction, since common spreaders can be used for several of the multiband elements.

Construction

Erecting the array was not unlike constructing a suspension bridge – single handedly, with tweezers. A tilt-over tower (40 ft) next to the house facilitated matters, but did not solve them. With the tower cranked over, it was possible to mount the boom to the mast and fasten three elements on one side. The remaining five elements had to be attached with the tower vertical but retracted, using a 12 ft stepladder borrowed from the Suburban ARC on the roof of the house. I used the spreader construction method described in the ARRL antenna book[3]. The bamboo poles were coated with three layers of acrylic varnish. Once the wire mounting points were determined on the spreaders, the poles were wrapped about 6 in. either way with several layers of vinyl tape, a small nail inserted through the tape into the pole, and the wire loop mounted on the nail, with a safety wire strung around the pole. The whole area was then liberally coated with acrylic varnish.

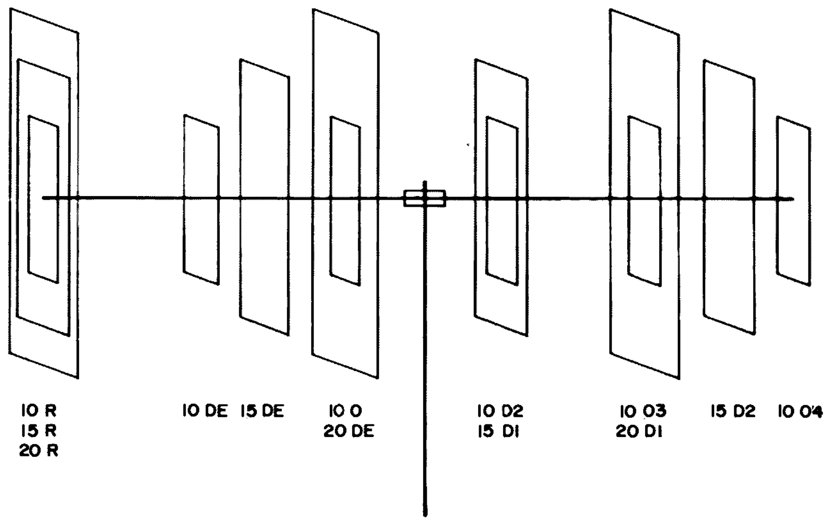


Fig. 1. The 3-4-6 Quad.

LIST OF PARTS AND PRICES:

32 bamboo pole (20 – 8 ft; 16 – 15 ft) $25
Acrylic varnish, U bolts, angle iron, hose clamps (with stainless screws), #16 wire, etc. 50
Boom: 2 in. OD 1/8 in. wall. Two 24 ft sections had to be purchased. After cutting, two 9 ft sections remained but will come in handy on Field Day. Also, 4 ft sleeve for joining at center. 55
Aluminum plates for spreader and boom mounting (from junk yard). 10
Coax, RG8/U (3 – 75 ft rolls). 25
3 baluns. 45
$210

A steel boom would have been cheaper but would put great strain on the rotor, tower and operator. At the soldered junction points and wherever water seepage could cause damage, General Electric silicone seal, a white rubber sealant, was used. It can be removed with a knife if necessary but will not wear off and is not conductive.

The loops were first constructed using dimensions from Lindsay's article in the May 1968 QST[2] but I found that a ± director–reflector tuning[1] broadened the front-to-back across 20 and 15, although the peak dropped a few dB. I used ±3% tuning on 10m (D.E. resonant at 28.5 MHz) because of my SSB preference on that band. 16-gage wire was used throughout although any soft drawn wire of at least that gage will work.

The boom droop is minimal as is wind sway. I use no boom-end to mast support but in windy areas it might be advisable. Thus far the structure has withstood 45

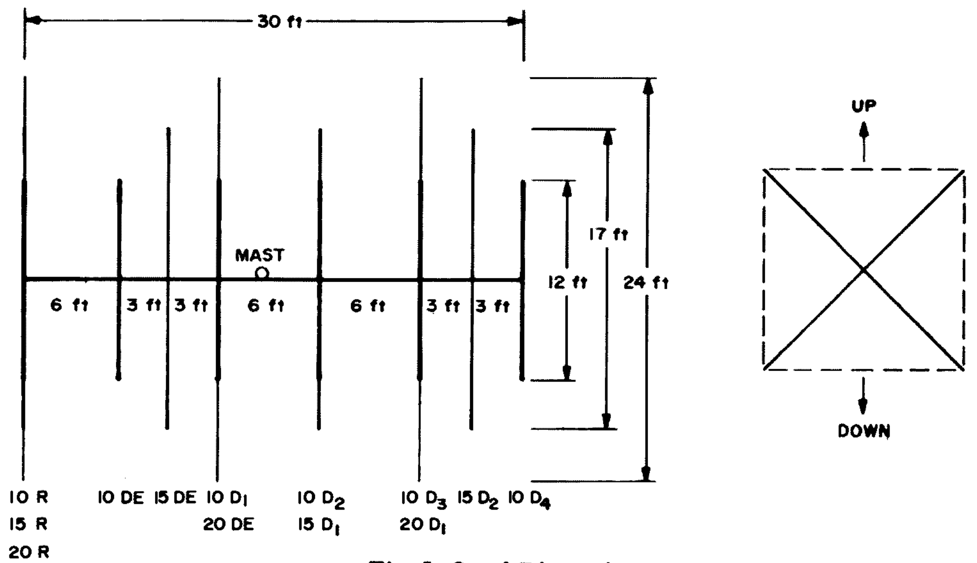


Fig. 2. Quad Dimensions.

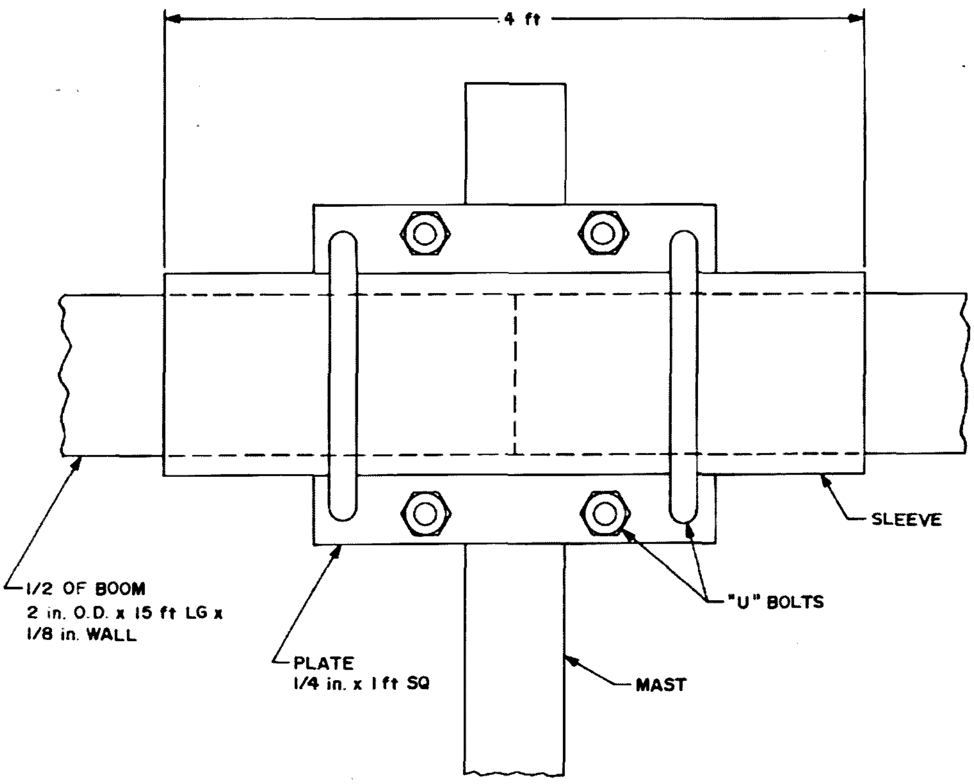


Fig. 3. Boom mounting detail.

mph gusts without damage.

Results

A first attempt at using the array produced an interesting result: on 20m, signals from the west coast peaked with the quad beaming north northwest (the rotor was calibrated correctly!). Insertion of a balun cured the problem; it appears that radiation from the coax feed line skewed or distorted the pattern.

Each driven element is fed separately with RG-8/U through a balun. The swr curves were adjusted for mid-band minimum by adding or detracting a few inches betweeen the driven element loop tie points and the balanced terminals of the balun. There appears to be negligible coupling between loops of different bands.

Pattern tests were made with six local stations in a 3–20 mile radius under "closed band" conditions to minimize backscatter effects. An arithmetic mean of all data resulted in the following:

Front to:	10m	15m	20m
side:	68 dB*	48 dB	35 dB
back:	36 dB	27 dB	25 dB

*very sharp nulls.

It was impossible to make forward gain tests, but on the air success and the above front-to-side and -back figures suggest substantial forward-gain characteristics.

This antenna is most effective under long skip conditions, which supports the quad's purported low angle of radiation character. Often in the morning on 10 European and African stations tell me that mine is the "first Stateside signal of the day," or that K3MNJ is one of the strongest signals on the band. While these are rather subjective criteria, it is clear that there is a marked improvement over the old triband yagi.

Care must be taken though in directing the antenna properly, particularly on 10 and 15, as the major lobes are sharp and 20 dB increase in reported signal strength by correction of a 22° heading error is not unusual; an African opening on 10 might be missed if the antenna is fixed on Europe!

. . .K3MNJ■

[1]Orr, "All About Cubical Quad Antennas," Radio Publications, First. Ed.
[2]Lindsay, "Quads and Yagis," May QST, 1968.
[3]ARRL Antenna Book, 11 Edition, P. 271.

EXTRA!

(Special to 73 Amateur Radio News)

OSCAR FLY-BY SUCCESSFUL

Harold J. Wheelock W6SCW

Test flight AA2, the second airborne test of the type of equipment to be orbited on AMSAT-OSCAR-B (AO-B) early in 1972, was successfully conducted on September 25, 1971. Taking off from Van Nuys airport, northwest of Los Angeles, at 0900 PDT, the aircraft covered about 1,100 miles, flying over California's most populous areas, including about 50,000 licensed amateurs within line-of-sight of the plane. Proceeding south to the San Diego area at an altitude of 11,500 ft, it returned past Los Angeles airport at 12,500 ft, traversing the Elsinor-Corona region en route, then over Ventura, Santa Barbara, Paso Robles and Hollister, before landing at Palo Alto for refueling and lunch at 1310 PDT. The home leg of the flight began at 1545 PDT and took the plane over Sausalito, Sacramento, and down the central valley past Fresno and Bakersfield, landing at Van Nuys at 1837 PDT, some 7 flight hours after take-off.

The airplane, a Bonanza-J, was piloted and owned by Booth Hartley K6KVC. Maurice Piroumian WA6OPB served as co-pilot and flight project engineer; he maintained ground contact in a housekeeping net on 18590 kHz, reported position and other flight information to the ground net. Dick Ulrich K6KCY, the third member of the flight crew, functioned as repeater flight test engineer, kept the equipment on the air, scanned and recorded the repeater output and maintained operating logs.

Flight test AA-2 was sponsored by AMSAT and the Amateur Radio Club of the Jet Propulsion Laboratory, Pasadena, California, assisted by the Radio Club of Goddard Space Flight Center and many individual and organizational members of AMSAT.

Test AA-2 was preceded by about three months of intensive preparation including three short flights in the Los Angeles area. One was an aircraft belonging to Ted Reid W6HR and the others with the plane of Booth Hartley K6KVC. During this period the flight preparation activities were coordinated nightly on 3860 MHz, with Helmut Mecke W6ZGC as net control.

The transmitter repeater equipment was identical to that flown in Test AA-1 on May 15-16, 1971, on the East Coast. It operates on a 2-meter passband from 145.83 to 146.07 MHz. The airplane signals are translated to 10 meters for retransmission by the repeater within a segment extending from 29.38 to 29.62 MHz, being inverted in the process (upper sideband becomes lower, space becomes mark, and RTTY, and higher frequencies on the 2-meter uplink become lower in the repeater 10-meter output). A beacon signal continually transmits HI in code on 29.45 MHz as a marker for the listeners. The repeater will accept single sideband, CW, AM RTTY and slow-scan TV signals.

Although the 2-meter uplink was essentially limited to line-of-sight, the 10-meter transponded output was expected to permit communications out to 150 to 200 miles, depending upon atmospherics and the mountainous California terrain.

Uplink signals to the airplane were received on omnidirectional monopole antennas that replaced the navigational equipment on the plane. A center-loaded whip mounted parallel to the bottom of the fuselage in a longitudinal direction handled the repeater output on 10 meters. A third antenna on top of the airplane carried the ground housekeeping net, utilizing a modified monopole radiating the output of the transceiver furnished by Ted Henry W6UOU.

A ground network to provide flight status on 7225 MHz monitored the aircraft, advising listeners of its location and the progress of the test flight. Dennis Monroe WB6IOE was net control, using the station facilities of W6ZGC. The status net control was transferred to Cliff Buttschardt W6HDO when the airplane reached the San Francisco peninsula area.

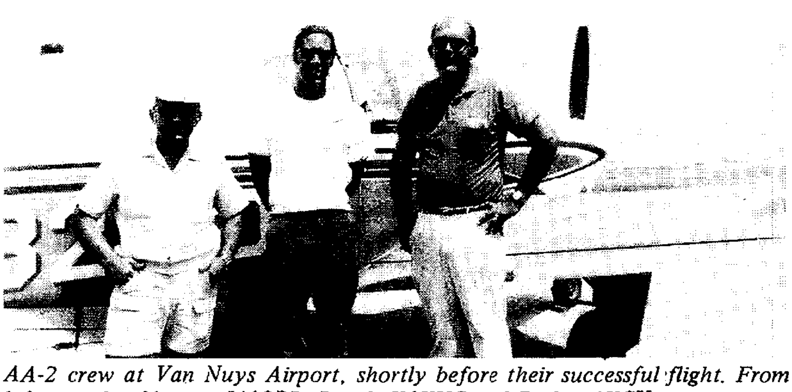
A key ground station was operated as W6JPR/portable 6 on 8830 ft Mount Pinos, about 85 miles northwest of the Los Angeles City Hall. Five selected stations, two in the San Fernando Valley, one in San Diego, one at Los Altos near Palo Altos, were scheduled to attempt contact to the repeater every 15 minutes to test the range and conditions encountered in cross-channel airborne repeater operations.

The JPL Amateur Radio Club provided facilities for monitoring the test by officials of AMSAT listening on the East Coast. This phase of the operation was handled by Rex Edwards W6IIN, who manned theJPL Club's home station W6VIO, and patched the signals by telephone to AMSAT at Goddard Space Flight Center near Washington, D.C.

The AA-2 overflight and transmitter repeater tests were set up as a contest using the same rules that applied to the May 15-16 test in the East. All details of the contest will be handled through WA3NDS and QSLs should be mailed directly to P.O. Box 27, Washington, D.C. 20044.

Here is a preliminary report:

1. Flight AA-2 did not encounter the weak 10-meter output as reported during the East Coast test.
2. The repeater successfully passed AM signals, particularly if they are held below the saturation point of the repeater on modulation peak.
3. While en route to San Diego, repeater output power was reduced from 1W to 200 mW because of distortion from strong signals, causing the repeater to oscillate.
4. Almost every type of legal emission was heard through the transponder, including SSB, CW, FM, AM and some TTY.
5. No accurate count of contacts through the repeater can be made at this time, but the flight crew reported monitoring as many as 125 stations during the flight. Many others – particularly on CW – could not be logged because of simultaneous transmissions.



AA-2 crew at Van Nuys Airport, shortly before their successful flight. From left to right: Maurice W6OPB, Booth K6KVC and Dick K6KCY.

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Small Boxes for Small Projects

In this age of microminiaturization it is often impossible to find suitable housings for homebrew transistor and IC projects. The smallest minibox I have been able to locate is 2¾ x 2 1/8 x 1 5/8 in. This was small in the heyday of vacuum tubes – in fact it wasn't bad in the early days of transistors. Unfortunately the utility box manufacturers have not seen fit to produce truly small boxes for truly small projects. By this I mean not only the one or two transistor or IC project but also the more elaborate type. Suppose you were to build a project on a PC board measuring 3¾ x 4¾ in., the height of the components above the board were ¾ in., and clearance below the board required another ¼ in. The ideal housing for such a project would be 4 x 5 in. times perhaps 1¼ in. A check of catalogs indicates the closest standard box to be 4 x 5 x 3, or nearly three times the volume of the required housing.

Fortunately there is available a wide variety of combinations of width and depth. The major stumbling block is height and this is the dimension which can most easily be modified. After your PC board size is chosen on the basis of the size and number of components to be used, find a standard box which most nearly approximates that size in width and depth. If the exact size is not available, consideration should be given to a slight redesign to accommodate the discrepancy. The project should then proceed as usual until the final packaging phase is reached. Carefully measure the overall height of your project, allowing a slight amount of clearance (perhaps 1/8 in.) to preclude the possibility of shorting the foil on the bottom or mashing a component on the top.

Take the chosen box apart and with a hand nibbling tool cut away those portions of the box not absolutely necessary. In this way it is possible to make a wafer-thin box if need be.

The case for a toroidal vfo presently under test at this QTH was reduced in size by over 4 cubic inches as compared to the smallest standard box. . . .WAØABI

"As soon as you can send 13 wpm, you can beat the big drum."

Let's Revise The Morse Code

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Nampa ID 83651

Probably nothing in ham radio has caused so much frustration to some and given so much pleasure to others as the Morse code. Nothing is more pleasant to the proficient CW operator than the rhythmic flow of dahs and dits being translated automatically and almost subconsciously into a message from a fellow amateur. The use of a special code, a semiprivate language, appeals to some innate, primeval instinct in us. We all know how children's imaginations are captured by speaking pig-latin or exchanging secret messages in codes or ciphers, and if we are honest, we will admit that even we adults have not completely outgrown this impulse toward the mystery of a semiprivate language. From a technical viewpoint, no one has yet proposed a simpler radio communications system than CW for getting messages through under marginal conditions.

But think of the millions of hours of pain, frustration, boredom, and who knows what else suffered through by aspiring amateurs trying to achieve the magic speeds of 5, 13, and 20 wpm. It has been estimated that 70 hours of practice are needed to attain 13 wpm. Multiplying 70 hours by 250,000 amateurs gives the staggering total of 17.5 million hours, or 2000 years, as the amount of time that U.S. amateurs have devoted to achieving the level of proficiency required for a General class license.

Why is Morse Hard to Learn?

Why does Morse code require so much effort to learn? The main reason is that it must be learned through listening and not by seeing. Anyone who has read code off visually from a moving perforated paper tape soon realizes how much faster and easier he can copy from the visual signal than from corresponding audio code signals. Granted this basic difficulty of having to introduce information into our brains through the inherently more sluggish audio channel, still Morse code as it is currently structured is more difficult to learn than it need be. Some judicious revisions of the code could dramatically reduce the amount of practice time required for achieving any given code speed.

When you begin to think of tinkering with the structure of the code, a lot of possibilities present themselves. One could, for example, change the relative lengths of the dots and dashes from their present 1:3 ratio, or introduce new basic characters in addition to the current dot and dash. But drastic changes that would leave most of the existing code characters unchanged

could nonetheless make CW proficiency a lot easier to achieve.

There are two fundamental features of the present code which limit proficiency unnecessarily. First, some characters sound too much alike; second, the rate at which characters must be decoded changes by a factor as high as three or four, depending upon whether a sequence of short-length or long-length characters is being received.

Structure of Morse Code

We normally think of Morse code as made up of dots, dashes, and spaces. Although our attention is generally focused on the dots and dashes, we realize that the spaces are just as important in conveying information. The term *bit*, borrowed from the world of computers and digital devices, is convenient for describing the code. As seen in Fig. 1, one bit is equivalent to the time for making a dot, and a dash requires three bits of time. A character is some unique combination of dashes, dots, and

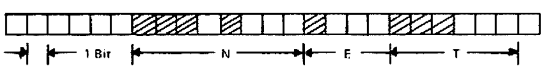


Fig. 1. Basic code character structure.

spaces representing a particular alphabetic letter, a numeral, a punctuation mark, or other signal information. The three empty bits following the last dot or dash in a character should be considered as part of the character because they must be left free or open. Two additional free open bits, or a total of five, are used as the space between words. From Fig. 1 we see that the letter N requires eight bits, the letter E is four bits long, and T is six bits long. From Fig. 2, which lists the number of bits required for each of the commonly used characters, one notices that characters vary in length from 4 to 22 bits, a ratio of greater than 1:5.

Is Morse Efficient?

From the viewpoint of encoding the letters of the alphabet into Morse with the fewest number of bits, the Morse code is fairly well designed, since the most frequently occurring letters generally require the smallest number of bits. According to Britannica, the letters of the alphabet occur with the frequencies shown in Fig. 3. The numbers listed by each letter give the average number of times that letter is found per 1000 letters in ordinary English text.

Number of Bits	Character
4	E
6	T, I
8	A, N, S
10	D, H, R, M, U
12	B, G, F, K, L, V, W, 5
14	C, O, P, Z, Z, 4, 6
16	J, Q, Y, 3
18	2, 8, question mark
20	1, 9, period
22	Ø, comma

Fig. 2. Length of characters in bits.

E	126	U	30
T	90	P	27
R	83	M	25
I	76	Y	21
N	76	G	18
O	74	W	14
A	72	V	13
S	58	B	11
D	40	X	5
L	36	K	3
C	33	Q	3
H	33	J	2
F	30	Z	1

Fig. 3. Frequency of occurance of letters in ordinary English.

Comparing the information in Figs. 2 and 3 shows that although the most frequently occurring letters usually require the fewest number of bits, there are exceptions. For example, the letter O is much higher in the frequency list than is X, but both require 14 bits. The letter K, which occurs only three times per 1000 letters, requires 12 bits while C, which occurs thirty-three times per 1000 letters, requires 14 bits, and you can easily find other such peculiarities. In all fairness it should be noted that the given frequency counts are based on the English language, and Morse is certainly used with other languages having different occurrence frequencies.

Momentary Speed Bursts

If one wanted to revise the Morse code so that an English language message could be transmitted using the fewest possible number of bits, then changes should be made strictly on the basis of how frequently the letter occurs. This type of revision would be excellent if at the receiving station the translation from Morse to English were done by a machine, but usually a human brain serves as a decoder, and the brain decodes most accurately when the rate at which code characters (not bits) being received is uniform, especially when near the upper limit of receiving ability. When we say that code is being sent at a constant speed, we usually mean at a constant bit rate. But even though the bit rate is held constant, as it will be in properly spaced code as produced by perforated paper tape or a proficient operator using an automatic key, the rate at which characters arrive for decoding will vary widely because of the marked differences in character lengths. Compare the two phrases "Your QSO could . . . " and "I see a teen net . . . ". Each phrase contains 12 characters, but the first one requires 154 bits and the second only 80 bits for transmission. If both phrases were sent at the same rate of 10 bits per second, the first would require 15.4 seconds and the other 8.0 seconds. The rate in words per minute for each could be calculated as follows:

For phrase 1

$$\frac{\text{12 characters x 60 sec.}}{\text{5 characters/word x 15.4 sec.}} = 9.35 \text{ wpm}$$

For phrase 2

$$\frac{\text{12 characters x 60 sec.}}{\text{5 characters/word x 8.0 sec.}} = 18.0 \text{ wpm}$$

If these two phrases were sent at the same constant bit rate as would normally be the case, for parts of one message or transmission, the rate in characters per minute and words yer minute would nonetheless vary by a factor of two. A detailed calculation shows that for average English copy the above rate of 10 bits per second corresponds to an average word-per-minute rate of 12.5. No wonder the poor ham's brain begins to saturate, stutter, and stumble when the rate temporarily zooms from its average value of 12.5 wpm to 18 wpm.

"If it weren't for the momentary speed burst effect, I could copy 20 smoke signals per minute easy."

The technique of copying behind can smooth out these rate variations to some extent, but most of us cannot copy far enough behind to really help the situation appreciably. The next time you are copying code at near your top speed, notice where you tend to drop out two or three letters. It will usually be in a sequence of several short-length characters where the wpm rate temporarily goes way over your top copying speed as a result of this momentary speed burst effect.

Group		
1	D	— - -
	B	— - - -
	6	— - - - -
2	U	- - —
	V	- - - —
	4	- - - - —
3	I	- -
	S	- - -
	H	- - - -
	5	- - - - -
4	J	- — — —
	1	- — — — —
5	Z	— — - -
	7	— — - - -

Fig. 4. Groups of Morse code characters having similar sounds at high speeds.

Characters That Sound Too Much Alike

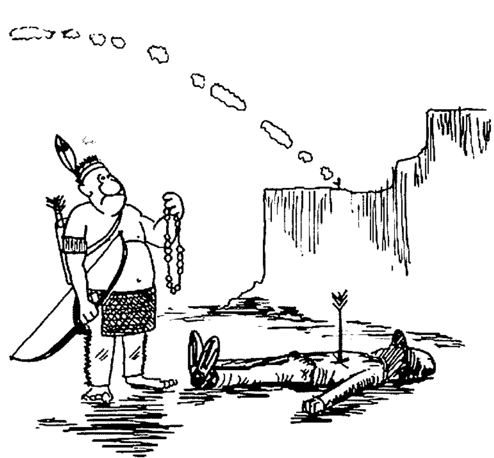
A second source of errors made when copying at near top speed results from mistaking characters that sound too much alike. It would be hard to find an operator who has not mistaken an S for an H or a V for a 4. Figure 4 lists groups of characters whose adjacent members are easily confused at high speed. By high speed, I mean any speed near the top limit of the operator, and also high enough so that he can no longer count the number of dits or dahs but is wholly dependent on the characteristic sound of the letter. My guess is that with most operators, trouble with characters having similar sounds sets in at about 12 wpm, while the momentary speed burst effect starts giving real trouble in the neighborhood of 18 wpm.

Solution for Momentary Speed Bursts

So much for the problems. Are there any solutions? Let's look first at the momentary speed-burst effect caused by sequences of low bit characters. This problem could be brought under control by modifying the letters E, T, and I. Since these letters occur so frequently and are so short, replacing their present representation by longer combinations would have a very favorable effect on smoothing out the rate at which an operator decodes Morse, but we will pay for this smoothing out of the rate, of course, by having to use more bits for a given message. However, the number of characters to be decoded in the message will not be changed, and the more uniform rate at which characters arrive will enable the operator to achieve a marked increase in his decoding rate.

Solution for Characters Which Sound Alike

What could be done about the second problem, the difficulty of distinguishing characters which sound too much alike? Consider group 1 in Fig. 4, that is, D, B, G. The adjacent letters are the ones which the operator has trouble differentiating. Hardly anyone would mistake a D for a 6, and D and B usually cause little difficulty, but B and 6 are another matter. A new distinctive sound for B would cure the difficulty with group 1. Similar problems with U, V, and 4 could be solved by using a new combination for V, and the confusions within the group S, H, and 5 would be eliminated by a



"Do you suppose the chief could've sent 'bead' not 'dead'?"

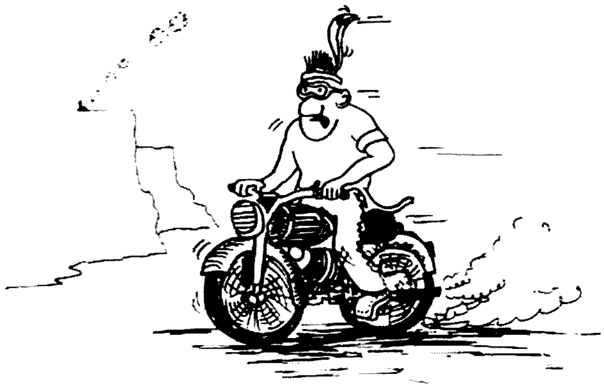
different character for H. Since the two groups J & 1 and Z & 7 do not give so much diffiuclty, and since J & Z only occur but a couple of times per 1000 letters on the average, let's not change them.

New Morse

The letters to be changed then are E, T, I, B, V, and H. What shall we change them to? Nearly all the distinctive sounds made by using two, three, or four dot-and-dash combinations have been preempted for other letters or symbols. Some which seem not to be in use are actually reserved for letters not in the English alphabet. If our new Morse is to be international, we should leave the combinations used for the foreign letters alone. There are, however, some rather distinctive sounding five-element combinations that are available. After some cogitating and playing around with a key, I am suggesting the characters shown in Fig. 5 for the *New Morse*. All other presently used characters would remain unchanged. Note that although these new characters are five-element combinations, the number of bits required is not greater than for such letters as C, O, P, X, Z, or J, Q, Y. Looking at Figs. 2 and 5, we see that in the ordinary Morse, the characters used for letters vary in length from 4 bits up to 16 bits, a ratio of 4:1, while in *New Morse* the variation is only from 8 to 16 bits, a 2:1 ratio. These numbers demonstrate that characters will arrive for decoding at a much steadier rate with *New Morse*.

	Character in New Morse	Number of Bits
E	· · — · ·	14
T	— · — · ·	16
I	· · — · —	16
B	· — — · ·	16
V	· · · — ·	14
H	· — · · —	16

Fig. 5. Characters suggested for New Morse.



"Why can't he stick to old Morse when he sends smoke signals. If there is anything I can't stand, it's Indians who don't stay with the good old ways."

Both dialects of Morse, old and new, would be compatible because no code character would have two meanings. An operator knowing both could copy either form with no ambiguity.

The number of bits required to send a given plain English message will be about 30% greater for New Morse, but don't let that number frighten you. The number of characters to be decoded will be exactly the same in both, and they will arrive at a much steadier rate. The confusion over similar sounding characters will have been eliminated, enabling the operator to copy New Morse more accurately and at a higher number of words per minute.

What Shall We Do?

Perhaps New Morse is not the best of all possible codes that could be devised, but it does point out the ways in which marked improvements could and should be made. If so, then this article has been successful. Some national or international organization should take it upon itself to make a thorough study of the best way to improve the Morse code. Experiments under carefully controlled conditions carried out by a team of professionals would lead to the development of a code far superior to the present Morse. Just as we ought to abandon our cumbersome and awkward English units of weights and measures in favor of the simpler and more efficient metric system, so we ought to modify the Morse code into a form more suitable to this last third of the twentieth century.

. . .W7OXD■

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A Pi-Net For Transistor Finals

Probably the most difficult part of a transistorized final amplifier to design is the tank circuit. The main reason for this problem is that transistors must operate into a low impedance load and therefore circuits used with tubes are not satisfactory. Also, information about good tank circuits for use with transistor amplifiers has not been available in a form useful to most amateurs.

Several approaches have been used to obtain a suitable tank circuit. One circuit used often by amateurs is the double-tapped tank in which one tap on the tank coil is connected to the transistor and the other is connected to the antenna. This works, but is difficult to adjust.

An approach used by some manufacturers is to use two π-nets with their high impedance ends connected together. The transistor is connected to the low-impedance end of one π-net and the antenna connected to the other. This circuit also works, but uses a relatively large number of components.

In addition to the circuits discussed above there are several other possible circuits. Many of these are not convenient if the operating frequency or the load impedance is variable.

The Purpose of the Final Tank Circuit

The final tank circuit should attenuate signals whose frequency is different from the desired frequency and it should provide a means for coupling the rf energy to the antenna. It is desirable that the tank coupling be adjustable to allow loading of a range of variation of antenna impedance. The resonant frequency of the tank should be variable to allow the tank to be used over a band of frequencies. In addition, the tank must present the proper load impedance to the amplifying device if maximum amplifier efficiency is to be obtained.

The π-Net

A tank circuit widely used with vacuum tubes is the *pi* network, or π-net. This circuit is very useful because it can perform all the needed and desired functions of the tank circuit using only three components: two capacitors and one inductor. The inductor is normally fixed in value and both capacitors are variable. One capacitor is used to tune the π-net to resonance and the other capacitor is used to adjust the coupling between the tank and the antenna.

In the form usually used in vacuum tube circuits, both capacitors are connected to ground. The tube is connected across one capacitor and the load across the other (Fig. 1). This circuit works very well for tube circuits where the load impedance must be fairly high, usually at least 2 kΩ. It is not satisfactory for transistor circuits, however, because most transistors must operate into a load impedance of less than 100Ω and the size of the capacitors be-

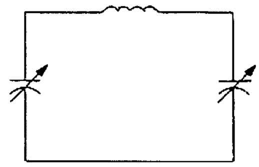

Fig. 1. Capacitor input π-net.

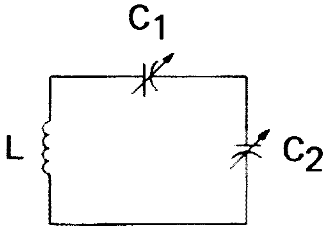

Fig. 2. Inductor input π-net.

comes very large when an input impedance of this magnitude is needed. A typical capacitor value for an 80m tank is 0.01 μF. Variable capacitors of this size are impractical.

Fortunately for builders of transistor equipment, there is a form of π-net coupling circuit that can work very well with transistors. This circuit retains all the advantages of the conventional π-net and still allows a low load impedance to be presented to the transistor. As shown in Fig. 2, the loading capacitor and the inductor are connected to ground and the tuning capacitor is "floating." This form of π-net is called an inductor input π-net and it functions essentially the same as the capacitor input circuit. The input impedance is high for both, and circuit values are similar for the same input impedance and frequency. There is one difference that makes the inductor input π-net useful for transistors, and that is a low input impedance can be obtained by coupling into the inductor with a link. The impedance level is lowered by transformer action.

There are actually several possible arrangements of the inductor input π-net. Figure 3 illustrates these.

In sketch A (Fig. 3) one side of the inductor and one side of the loading capacitor is connected to ground. The rf energy is coupled into the π-net by a link.

In B, the loading capacitor is connected to ground and the bottom of the inductor is at ground potential for rf because of the large bypass capacitor. The collector is connected to a tap on the π-net inductor and the impedance is transformed down by this autotransformer connection. The dc also flows through the inductor. This circuit requires a minimum of parts.

In C, one side of each of the capacitors is connected to ground and the inductor is floating. Rf is coupled into the π-net by a

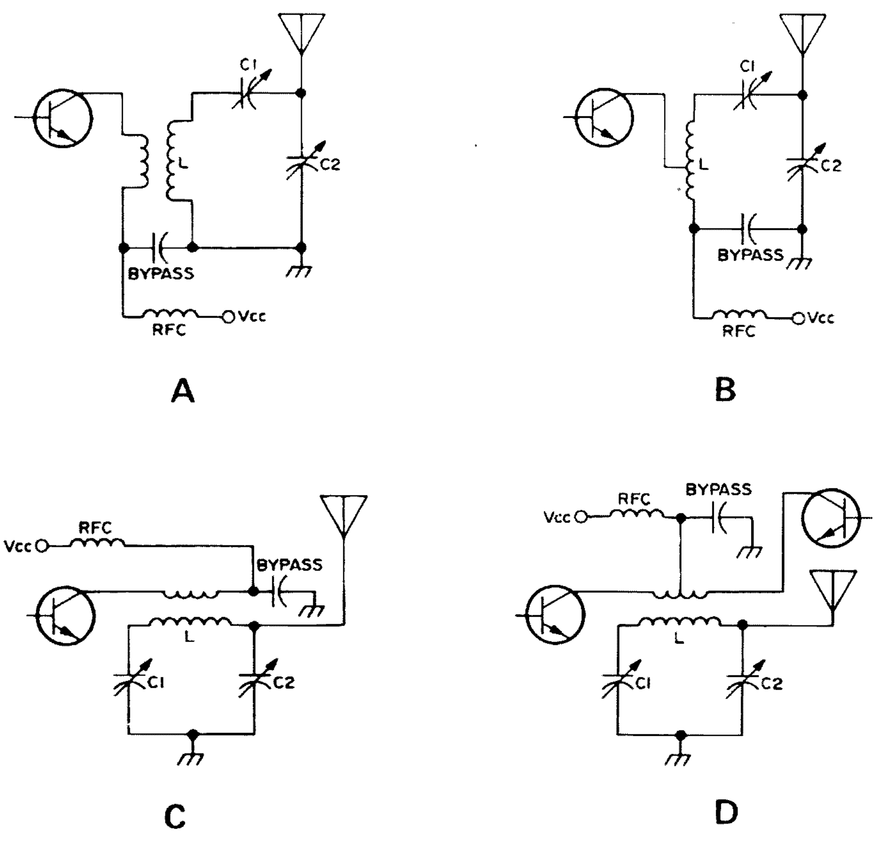

Fig. 3. Four ways to connect the π-net.

link. This arrangement eliminates the primary disadvantage of the circuits shown in the previous two figures, which is that the tuning capacitor must be isolated from ground. The inductor can float because the link isolates the inductor from the dc portion of the transistor circuit and the rf is still applied across the inductor. If a link is to be used, this is the preferred arrangement.

If push-pull operation is desired, the circuit of D may be used. The collector supply voltage is connected to the centertap of the link and the transistors are connected to each end of the link as in the conventional push-pull circuit. Push-pull operation may also be accomplished by using a centertapped link with the circuit shown in A.

It is actually easier to work with the inductor input π-net than it is to work with the capacitor input π-net. With the capacitor input π-net it is necessary to design a completely new tank circuit each time a different load impedance is needed. With the inductor input π-net all that is needed to change the load impedance is to change the number of turns on the input link. The basic π-net remains unchanged and all that is changed when a different input impedance is needed is the number of turns on the link.

The Universal π-Net

It is possible to use one basic π-net circuit for all input impedances and it is possible to design a universal π-net circuit. The universal π-net is described by giving reactance values for the inductor and the capacitors. The value of inductance and capacitance is then calculated for the desired operating frequency.

The universal π-net is designed by first choosing an input impedance across the entire inductor. The Q of the tank is designed to be at least 12 to obtain good suppression of harmonics. The value of inductive and capacitive reactance and the tuning range of the capacitors required to tune across the amateur band with the highest percent bandwidth and to load the desired variation in antenna resistance is calculated.

For those interested, the following equations are the basic design equations for the inductor input π-net.

$$X_L = \frac{R_r}{Q}$$

$$X_{c2} = R\sqrt{\frac{R_r}{R(Q^2+1) - R_r}}$$

$$X_{c1} = X_L - \frac{X_{c2}\,R^2}{R^2 + X_{c2}^2}$$

The reactance values, X_L, X_{c1}, and X_{c2} are for the inductor and the capacitors shown in Fig. 2. The input impedance across the entire inductor is defined as R_r and the antenna resistance is defined as R. The equations work if the Q of the circuit is greater than 10 and if R_r is greater than R and smaller than $R(Q^2 + 1)$. Also, the source of rf energy must not load the tank.

These basic equations were used to design the universal π-net tank circuit shown in Fig. 4. The reactance values at the center frequency of the band are shown in the figure for each of the components of the tank. The values of inductance and capacitance must be calculated at the center frequency of the band in which the π-net is to be used.

This tank circuit was designed to have 4 kΩ input impedance across the entire inductor. Its Q is 15 in the center of the band, 13.95 at the upper band edge and 16.2 at the lower band edge. It is designed to match resistive loads between 30 and 200Ω. The π-net can operate over a 15% bandwidth.

The input impedance was arbitrarily chosen to be 4 kΩ. This impedance level is higher than would ordinarily ever be needed in a transistor circuit and at this level there is not an excessive amount of interaction between the tuning and loading controls. Also, reasonable circuit values are obtained.

The Q at the center of the band was chosen to be 15 and the lowest Q in the

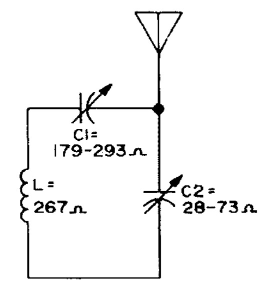

Fig. 4. Universal π-net

Table 1					
Inductor and Capacitor Values					
Band	L	C_1 (pf)		C_2 (pf)	
	(μh)	Min	Max	Min	Max
160	22.36	286	468	1155	2992
80	11.33	145	237	585	1516
40	5.94	75	124	307	795
20	3.00	38	63	155	401
15	2.00	26	42	103	268
10	1.47	19	31	76	197
6	0.82	10	17	42	109

band the π-net is designed to operate over is almost 14, exceeding the minimum usable value of 12.

The π-net can match resistive loads from 30 to 200 Ω. If the load contains either capacitive or inductive reactance, the tuning range of the loading capacitor may have to be increased since its value will have to be different to balance out the reactive component of the load.

In this article, percent bandwidth is defined as bandwidth/band-center X 100. The amateur band with the highest percent bandwidth is the 80m band with 13.33% bandwidth. The band with the lowest percent bandwidth is the 15m band with 2.12% bandwidth. The π-net is designed for a 15% bandwidth and is therefore able to tune across any amateur band. For most bands there is considerably more tuning range than necessary.

The π-net shown in Fig. 4 is general in nature and can be used for any band because reactance values are given for each of the components. When using the circuit at a specific frequency it is necessary to calculate the value of inductance and capacitance based upon the reactance and frequency. Since we are interested in using the circuit only in the amateur bands it is convenient to calculate the inductance and capacitance values for each of the amateur bands in which the π-net is useful. This was done and the results are tabulated in Table I. This table shows the value of inductance and capacitance needed for each of the bands, from 160 through 6 meters. The values were calculated assuming the center frequency of the π-net is at the center of the amateur band.

By using the values shown in Table I the design of the π-net is reduced to simply choosing capacitor values and designing the inductor.

Using the Universal π-Net

The inductance and capacitance values shown in the table are actual circuit values and include stray wiring capacitance and inductance. The capacitance would usually be made up of a fixed and a variable capacitor in parallel. The sum of the fixed capacitor, the minimum capacitance of the variable capacitor and the wiring capacitance should be equal to or less than the minimum value of capacitance shown in the table. The sum of the fixed capacitance, the maximum capacitance of the variable capacitor and the wiring capacitance should be equal to or greater than the maximum value of capacitance shown in the table. Wiring capacitance must be included and it is difficult to determine its value because it is dependent upon several factors including the circuit layout and compactness. It may be as high as 20 or 30 pF and is equivalent to adding a fixed capacitor in parallel.

If the inductance is not close to the proper value, it may be necessary to adjust capacitance values a little one way or the other to obtain full tuning range across the band, especially on 80m where there is very little extra tuning range. Also, if the wiring capacitance is not close to the estimated value, the value of fixed capacitance may have to be adjusted to compensate.

The inductor must provide the inductance value and it must act as the secondary of the input transformer. It can be either an air core coil or a toroid wound on a magnetic core.

The inductor may be wound using cut

and try methods if some method is available to measure the inductance, or the size of the coil and the number of turns can be calculated.

An ARRL Type A lightning calculator is very useful for designing air core coils. With it you can design coils with a wide variety of diameters and lengths.

The number of turns needed on a toroid to obtain the desired inductance can be calculated using this equation adapted from *Electrical Engineers' Handbook*, by Pender and McIlwain:

$$N = 9.92\sqrt{\frac{Ld}{A' + A(\mu - 1)}}$$

Where: N = number of turns
L = inductance in microhenrys
d = average diameter of core in inches
A' = area of coil at right angle to flux path in square inches
A = area of core at right angle to flux path in square inches.
μ = permeability of toroid core

If the coil is wound close to the core the equation can be simplified to the following:

$$N = 9.92\sqrt{\frac{Ld}{\mu A}}$$

Since the inductor is the secondary of the input transformer it is undesirable for it to have a small number of turns because the lowest input impedance will be fairly high, perhaps too high for the transistor it is to be used with. For example, if the inductor had five turns on it and a one turn input link were used the input impedance would be $4000/5^2 = 4000/25$, or 160 Ω. This is based on the classical impedance transformation equation for transformers where the impedance across the secondary is 4 kΩ and the turns ratio is 5.

In the case of air core coils, the smaller the diameter of the coil the more turns that are required. Therefore, if you cannot get a low enough input impedance, use a smaller diameter coil with more turns on it. Coils with a diameter of 1-1/2 in. are about right for 160m, a diameter of 1 in. works well for 80 and 40m tanks, and for 20 through 10m tanks, a diameter of 0.5 in. is suggested. On 6m, a smaller diameter may be needed, perhaps 3/8 in. There is nothing that says these diameters must be used. They are only suggested and it may be necessary to use something different in some cases.

It is undesirable to have a small number of turns on a toroid. There is an additional problem with toroids because it is not possible to have a fraction of a turn on a toroid. Each time the wire passes through the center counts as one turn. Therefore the input impedance and the inductance changes in steps as turns are added and if the number of turns is small the steps will be large. To increase the number of turns on the toroid, use a core with a low permeability (μ). Toroid cores are commercially available with permeabilities from 7 to over 200. Cores with low permeability are best for this circuit. The physical dimensions of the toroid core also influence the number of turns needed; however, the power input to the tank will probably determine the size needed. A very good article on the use of toroids in tank circuits, written by E. L. Klein (W4BRS), appeared in 73, June 1967.

It is desirable to have an idea of the number of turns needed on the input link. The following equation is based on the classical transformer impedance transformation equation and gives an indication of the number of turns to use on the input link. The equation is:

$$N_L = \frac{N_c\sqrt{Z_{in}}}{63.3}$$

The number of turns on the link is N_L, the total number of turns on the inductor is N_c, and the desired input impedance is Z_{in}. The above equation was derived specifically for the universal π-net where the impedance across the inductor is 4 kΩ.

This equation will be close for a toroid inductor where there is tight coupling between the windings, but gives only an indication for air core coils. Coupling

between the windings of air core coils is loose and the input impedance will actually be lower than indicated by the equation. Since the use of too low a load impedance may destroy the transistor due to excessive current, it is best to use more turns than indicated by the equation when using air core coils. The proper number will have to be determined experimentally by measuring the power output and power input and maximizing efficiency by varying the number of turns on the link.

If the autotransformer connection of sketch B in Fig. 3 is used, N_L in the equation is the tap point of the inductor in number of turns from the bottom. As with link coupling, the equation is accurate for toroids but only an indicator for air core coils. When using air core coils, it is best to tap higher than indicated by the equation and experimentally determine where to tap for maximum amplifier efficiency.

While either an air core coil or a toroid will work, the toroid has several advantages, among them, small size, low external field, and the toroid approaches an ideal transformer.

Since the toroid has a low external field, there is less chance of oscillation due to coupling between the final tank coil the tank coils of previous stages in the transmitter. Also, there will be little loading of the tuned circuit by nearby metal objects and the coil can be placed close to other objects, allowing a more compact circuit to be built.

The load impedance required by the transistor is needed if the previous equation is to be used to design the input link. The following equation can be used to calculate approximately the optimum load impedance.

$$Z_{in} = \frac{V_{cc}^2}{2P_o} \quad \text{(ohms)}$$

The collector supply voltage is represented by V_{cc} and the power output from the transistor is P_o.

Use As an Interstage Coupling Circuit

The π-net is also very useful for interstage coupling, such as coupling the driver transitor to the final. The π-net acts as a tuned circuit and allows the impedances to be matched between the driver and the final. Any of the basic circuits of Fig. 3 may be used. The amount of drive supplied to the final can be adjusted by varying the loading capacitor. It is much easier to turn a capacitor to adjust the drive than it is to change the number of turns on a link, as would be necessary if the final were driven from a link.

By using a loading capacitor somewhat smaller than the minimum shown in Table I, the π-net can drive loads as low as about 20Ω. This is sufficiently low for most transistors. If the input resistance of the transistor is smaller than this, the impedance across the inductor will be greater than 4 kΩ.

In applications where the operating frequency will not change greatly, small screwdriver-adjusted padder capacitors can be used when the π-net is used for interstage coupling. The circuit is tuned and then left alone unless a large change in frequency is made.

A Design Example

It is desired to build a transistorized final for 10m using a 2N2631. This transistor has a maximum collector-to-emitter rating of 80V when there is a low resistance path from the base to ground. It can operate up to about 175 MHz so will work well on 10m. It can dissipate 7W of power at a case temperature of 60°C (140°F) and therefore should be able to handle a power input of about 15W if the efficiency can be kept reasonably high.

Because the maximum rating between the collector and the emitter is 80V, the maximum usable power supply voltage is 40V. Because the highest power can be obtained at the highest possible supply voltage, a 40V collector supply voltage will be used.

Table I says the inductor should be 1.47 μH, the tuning capacitor C_1 should be variable from 19 to 31 pF, and loading capacitor C_2 will be between 76 and 197 pF.

A combination of fixed and variable capacitors must be chosen for the tuning and loading capacitors. A wiring capacitance of 15 pF will be assumed for each of these. The tuning capacitor must have a tuning range of at least 12 pF. A Hammarlund type HF-15 capacitor has a range of 2.8 to 17.5 pF or a tuning range of 14.7 pF. The sum of the minimum capacitance of the variable capacitor and the wiring capacitance (2.8 + 15) is 17.8 pF. The sum of the maximum capacitance of the variable capacitor and the wiring capacitance (17.5 + 15) is 32.5 pF. In this case, no fixed capacitor is needed because the wiring capacitance is large enough. It should be remembered however that 15 pF was estimated for the wiring capacitance and its actual value is unknown. Therefore, after the circuit is built it may be necessary to adjust the capacitance a little to be able to tune across the entire band.

The loading capacitor must have a tuning range of at least 121 pF. A Hammarlund type HF-140 has a capacitance range of 6.3 to 142 pF or a tuning range of 135.7 pF. The sum of the minimum capacitance of the variable capacitor and the wiring capacitance (6.3 + 15) is 21.3 pF. A fixed capacitor of about 55 pF will be needed to give the required minimum capacitance of 76 pF (76 – 21 = 55). A standard value is 47 pF and if this value were used, there would be about the same overlap on each extreme of the rotation of the capacitor. As in the case of the tuning capacitor, the wiring capacitance is only an estimate and it may be necessary to adjust the value of the fixed capacitor to compensate if the actual value is greatly different.

The inductor is to be a toroid. An Amidon Associates type "SF" core operates between 10 and 90 MHz and will therefore work well on 10m. The permeability (μ) of this core is 8. A core with an outside diameter of 0.5 in. should be large enough to handle the power output of this final. The inside diameter is 0.3 in. and the thickness is 0.19 in.

The coil will be wound close to the core so the simplified equation can be used. The average diameter of the core, d, is 0.4 in. (0.5 + 0.3/2). The area of the core, A, is 0.019 sq in. (0.1 X 0.19). The number of turns is then calculated:

$$N = 9.92\sqrt{\frac{1.47 \times 0.4}{8 \times 0.019}} = 19.5$$

Since a toroid must have a whole number of turns, either 19 or 20 turns could be used; however, in this example, 20 turns will be used.

The only thing remaining to be designed is the input link. The first step in designing the link is to determine the required load impedance. The supply voltage is 40V and the approximate power output is 10W. The required load impedance is then:

$$Z_{in} = \frac{40^2}{2 \times 10} = 80\Omega$$

The number of turns on the input link can now be calculated from the equation:

$$N_L = \frac{20\sqrt{80}}{63.3} = 2.83 \text{ turns}$$

The nearest whole number is 3 and the input link will use 3 turns.

Additional Notes

In the last year I have done considerable work with transistor power amplifiers using transistors designed to operate from a low supply voltage, such as 12 or 13.6V. I have discovered that many transistors of this type are unstable when the basic link-coupled inductor-input pi-net is used as the tank circuit. Fortunately, I have also discovered a simple way to prevent this instability. All that is required is the connection of a small capacitor from the collector to ground, as shown in Fig. 5.

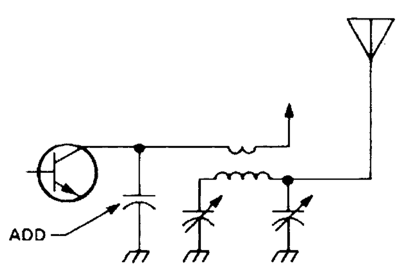

Fig. 5. Adding a small capacitor from the collector to ground will stabilize low voltage transistors.

The amount of capacitance required seems to depend upon the particular type transistor used and probably also upon the frequency of operation. All the amplifiers I have built using this capacitor to ground have operated in the high end of the 10m band. At this frequency a capacitance of 30 to 50 pF is normally enough to allow stable operation. The proper capacitor to use at lower frequencies will have to be determined experimentally and will probably have about the same capacitive reactance as the capacitor used on 10m.

Adding this capacitor does not change the basic operation of the circuit, but the value of C_1 will have to be reduced slightly to allow the π-net to resonate at the desired frequency.

The reason the capacitor improves stability is unknown but it does work and its use will allow you to successfully use the inductor-input π-net with transistors designed to operate from low power supply voltages..

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CHANGING THE 75S3
into a Better CW Performer

The 75S3 is an excellent receiver with an excellent 200 Hz CW filter that comes with it as standard equipment.

However, I found the 200 Hz filter too sharp for everyday use, whereas the 2.1 kHz filter is too broad. Due to its sharpness, the signals on the 200 Hz filter tend to ring, which can make a long session quite tiresome. An intermediate filter would be needed for normal use in CW operation, retaining the possibility to switch to 2.1 kHz for SSB or CW broadband net operation, and to 200 Hz for those really bad QRM situations.

On looking at the innards of the receiver, you will see that there is room for another filter and associated capacitors, and the holes are even drilled for them already. Changing the mode switch to one of five positions would be a major operation, but these days very few operators would object to giving up the AM position on the switch and substituting it for a 500 Hz CW position (especially if they are CW operators!).

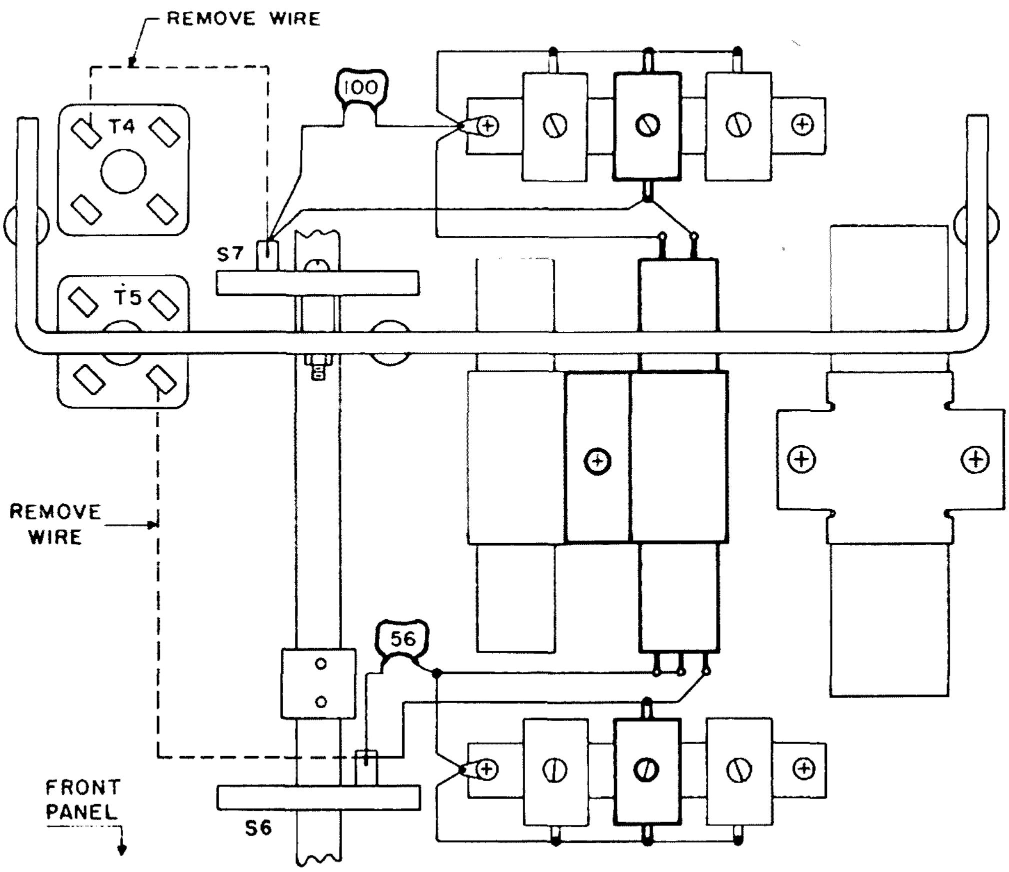

Fig. 1. Bottom view 75S3.

Collins sells a suitable mechanical filter (F455Y-05); the part number is 526.9521.001, and the price is $58. It comes complete with the little trimmers that fit into the holes in the strip on the chassis of the 75S3.

And while you are ordering from Collins, why not, for $1.50, order the hardware for mounting the filter, including two fixed capacitors, a clamp, and the wire needed for the connections. It's called an NPN installation kit.

Figure 1 shows the necessary changes in wiring needed to install the filter. What you do is simply substitute the i-f transformers T4 and T5, that are used for the wideband AM position, by the mechanical filter and associated capacitors, one of 100 and one of 56 pF, as indicated in Fig. 1, plus the two trimmers. Extra components are indicated in heavy lines.

After installation, all you have to do is provide a bfo voltage in the AM position of the switch, and connect the product detector instead of the AM diode detector to the i-f output.

Simply disconnect the lug on the wafer of the mode switch nearest the back of the receiver that is connected via a 100 kΩ resistor to pin 6 of the 6AT6, and reconnect this lug to the other three next to it (already connected together). The easiest way is to simply clip off and remove the 100 kΩ resistor that is no longer needed. You have now connected your i-f output to the product detector, and at the same time you are using the bfo in its variable position.

Align the filter by tuning the trimmers for largest signal of the internal 100 kHz oscillator on the meter, and you are in business.

The AM position of the mode switch gives you now 500 Hz selectivity without the "ringing" associated with the really very sharp 200 Hz selectivity. And when QRM really becomes bad you just flip the switch to the 200 Hz position and you will usually have a good copy again.

This investment has been one of my very best, and it has increased my pleasure in operating the 75S3 no end.

. . . OA4KF-PA0XE

WHY COAX?

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Most beam antennas are based on a driven element which is half a wavelength long. Almost all beam antennas are symmetrical—that is to say, there is exactly the same length of the same diameter of element on the left of the feedpoint as there is on the right—the same amount of inductance, capacity, traps, or other devices on both sides of the feedpoint.

It has, therefore, always puzzled me why, having achieved a beautifully symmetrical structure or balanced array, one should feed it with an unbalanced feedline like coaxial cable.

I am aware, of course, of the gamma match and the balun as a means of converting the unbalanced line to operate a balanced array (and these two devices will be discussed later), but there are still quite a large number of balanced antennas, beams, dipoles and the like fed directly with coaxial cable. In many cases these connect the center conductor of the coaxial cable to one side and the braid or outer conductor to the other side of the balanced array. See **Fig. 1**.

In the case of the gamma match (**Fig. 2**), the braid is normally connected to the *center* of the driven element which is in theory grounded while the center conductor is connected (at some distance appropriate to the impedance) to one side of the center.

In this case it is assumed that the braid or outer conductor is at ground potential. If this were actually true, the first example (connecting the braid to one side of the element and the center conductor to the other) could not work since one would then connect one side of the driven element to ground at the same distance from the center as the one which is driven on the other side. Yet, examples of the gamma match, and examples of connecting the coax cable directly to the element do work.

This must surely mean that in both cases a poor compromise is being achieved. The

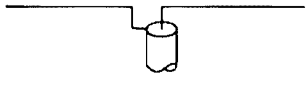


Fig. 1. Feeding a balanced antenna directly with coax.

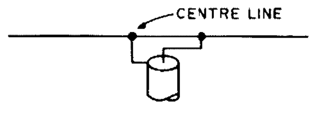


Fig. 2. The gamma match feed.

outer conductor or braid is neither genuinely grounded, nor is it genuinely hot to rf.

In the case where the coax cable is connected directly to the driven element (example 1) we must be assuming that the braid is not grounded, as we are using it to drive one side of the driven element. At this point surely it must be hot, and therefore for a considerable part of its length, the outer conductor must be carrying rf energy. Since it surrounds the inner conductor, the inner conductor cannot be radiating as it is completely shielded by the outer conductor and, therefore, it cannot balance this radiation. Thus we are producing a radiating feedline which must tend to accentuate TVI problems and, of course, upset the radiation pattern of the beam itself to some extent.

With the gamma match we assume that the outer conductor is grounded and we hope, therefore, that it is not radiating; but even in this case it seems a pity to drive a perfectly balanced array in a lopsided way on one side only and just hope that the other side will pick up the rf energy by resonance when we could, of course, feed the whole thing in balanced array by using balanced twin feedline.

But let us examine what chance we really have of grounding the outer conductor. Any conductor which is grounded at one end is no longer grounded as soon as we have traveled a quarter wavelength along this conductor away from the grounded point. In considering this quarter wavelength, we must remember that it is not only a quarter wavelength from the grounded point *at the frequency on which we intend to radiate*, but if there are harmonics present—and there very often are—then a quarter wavelength on the *frequency of the harmonic* from the grounded point and the outer cable is no longer grounded. For these reasons, it seems to me to be an illusion to imagine that the outer conductor of a coaxial cable can be regarded as effectively grounded throughout its length and, in fact if this were so, the system of connecting the coaxial cable directly to the antenna could not work.

If we were to use a balanced twin feeder instead of coaxial cable, we would not be deluding ourselves into imagining that one of the conductors was grounded. We would assume that both are hot to rf and, since they are 180 degrees out of phase, any radiation from the one conductor is balanced by the out-of-phase radiation from the other.

It may be argued that since most transmitters use pi-coupled output circuits, the transmitter is terminated by an unbalanced output and, therefore, we have difficulty in feeding a balanced feedline. Here I would advocate the use of a balun.

I am aware that there is a third method of using coaxial feeder to fit a balanced array—namely, by using a balun between the coaxial cable and the balanced array. This is, in my view, the best method of using the coaxial feedline and closely approximates the system I have just advocated of using a balun at the bottom of the feedline and feeding with a balanced twin cable.

In the case of the balun (balanced-to-unbalanced transformer), example 3, we undoubtedly have the best arrangement with this system if we *must* use coaxial line, since we are employing a device to convert the unbalanced feedline to a balanced feeder before connecting it to the balanced array.

There is still a certain disadvantage, however. Located at the top of the feedline close to the driven element, we will have a long coaxial cable for the whole of the length of the feedline and all the problems of radiation from the outer conductor still exist, but perhaps the most important disadvantage here is in feeding a lowpass filter. In the case of a lowpass filter designed for coaxial cable, the filter elements are connected in the center conductor and are so designed as materially to attenuate any harmonics which are present. If these harmonics are also present on the outer conductor (or braid) then these will pass through the metal case of the lowpass filter and, in effect, the filter is completely shorted out by the metal case.

Exactly the same applies in the case of a highpass filter connected to the input of a television set—the filter is again completely short-circuited by the case which connects the braid across the filter.

If, however, the balun is fitted close to the transmitter and the unbalanced output from the transmitter converted in a balanced feed, then a lowpass filter for twin feed with

the outer case insulated from both conductors can be used. Thus, the attenuation of harmonics resulting from the use of the filter will be effectively placed in *both* transmission conductors, and the metal case, although providing screening, will not act as short circuit across the filter elements. The outer case can be grounded or left floating, whichever is found more effective. This will often depend on the length of lead necessary to ground the case effectively.

From every point of view it would seem preferable to feed balanced arrays with balanced feedline, using a balun close to the transmitter to convert the unbalanced output of the pi output circuit to a balanced feeder. Then, if necessary, inserting a low-pass filter designed for twin feed, in which both conductors are balanced and insulated from ground.

Furthermore, a balanced feedline can be a 72Ω twin feed unscreened, since the close spacing between the two conductors and the fact that the currents flowing into each are equal and opposite, any radiation will be automatically balanced.

Since in this world nothing is perfect and it may well be found that the currents in the two legs are not always exactly balanced, a screened 72Ω twin feedline can be used to eliminate radiation which might arise from the fact that the two currents are not always exactly equal and opposite. However, in almost all cases, this will not be found necessary.

There is, however, one difficulty. Most modern beams are designed for 52Ω impedance feed.

At present no 52Ω impedance twin line exists and it is unlikely that such a low impedance line will be constructed in the near future, owing to the difficulty of insulating the two conductors; they would have to be spaced too close for practical manufacture. However, there is a vast amount of 72Ω twinlead available in most ranges of current-carrying capacity, and it would seem regrettable that beams are designed for a 52Ω impedance instead of for 72Ω impedance, for which twinlead is so readily available—and inexpensive.

. . . G3BID ■

IMPROVING The HEATH TUNNEL DIPPER

Walt Pinner WB4MYL
7304 Lorenzo Lane
Louisville KY 40228

The tunnel dipper, an excellent piece of test gear at its price, can be made even better with two simple changes.

You are cautioned in the instruction book that you may expect some downward drift of the meter during warm up. This drift has been eliminated by replacing the meter amplifier transistor Q3-2N185 with an inexpensive T1XMO5 transistor.

The second change recommended corrects the extremely fast rate of adjustment of the sensitivity control which makes obtaining a center scale reading of the meter difficult.

Replace the Sensitivity pot with a Mallory U-29 control (price approximately $1) and add a 56K resistor between the black lead to the original control and the new control. Add a 27K resistor between the white lead to the original control and the new control. Reconnect the center green lead directly to the new control.

If difficulty is encountered in swinging the meter through its complete range, due to the particular transistor in the unit, adjust the fixed resistor values slightly. If either of the values are changed, alter both to keep the total series resistance approximately 100 kΩ.

Five units have been modified in accordance with the above instructions and the ease of operation and improved stability have proven well worth the effort.

. . .WB4MYL■

communications yardsticks

Reprinted from the Lenkurt Demodulator

A yardstick is a measure of a two-way system's quality, quantity and performance. The often requested discussions of logarithmic units used to measure the quality of transmission systems is reprinted here with the addition of the metric units used internationally to measure absolute quantities.

Descriptive terms used in the telecommunications industry range from the infinitesimal – 1/1,000,000,000,000 watts/cm^2 (the power rating for conversational speech) – to the enormous – 6,000,000,000 Hz (the frequency of a typical microwave radio). Such a span would be unwiedly if simplifying expressions had not been established.

Powers of Ten

The first step to simplicity is a shorthand notation that expresses numbers as powers of ten. We know that 10 x 10 = 100 can be written 10^2. Likewise, 10 x 10 x 10 = 1000, or 10^4. By definition, an exponent of three means the number 10 is used as a multiplier three times. A frequency of 6,000,000,000 Hz then becomes 6 x 10^9 hertz (6 GHz).

Note that $10^1 = 10$ and $10^0 = 1$. Numbers smaller than one can also be treated using powers of ten. By definition, 10^{-1} is the same as $1/10^1$ or 1/10. In this way, the power rating for typical conversational speech, 1/1,000,000,000,000 watts/cm^2, can be written 10^{-12} watts/cm^2.

When discussing two relative values, it is sometimes convenient to use the term *orders of magnitude*. This is another way of expressing powers of ten. That is, one order of magnitude (10^1) is 10 times as much, two orders of magnitude (10^2) is 100 times as great, etc. Simple division indicates that a supersonic plane flying 1500 miles per hour is 100 times faster than a man jogging at 15 miles per hour. So, it can be said that the plane is two orders of magnitude faster than the man. Notice that orders of magnitude are really concerned with the exponent of the number.

Logarithms

All the numbers in these examples use the same "base" number of ten. If we treat

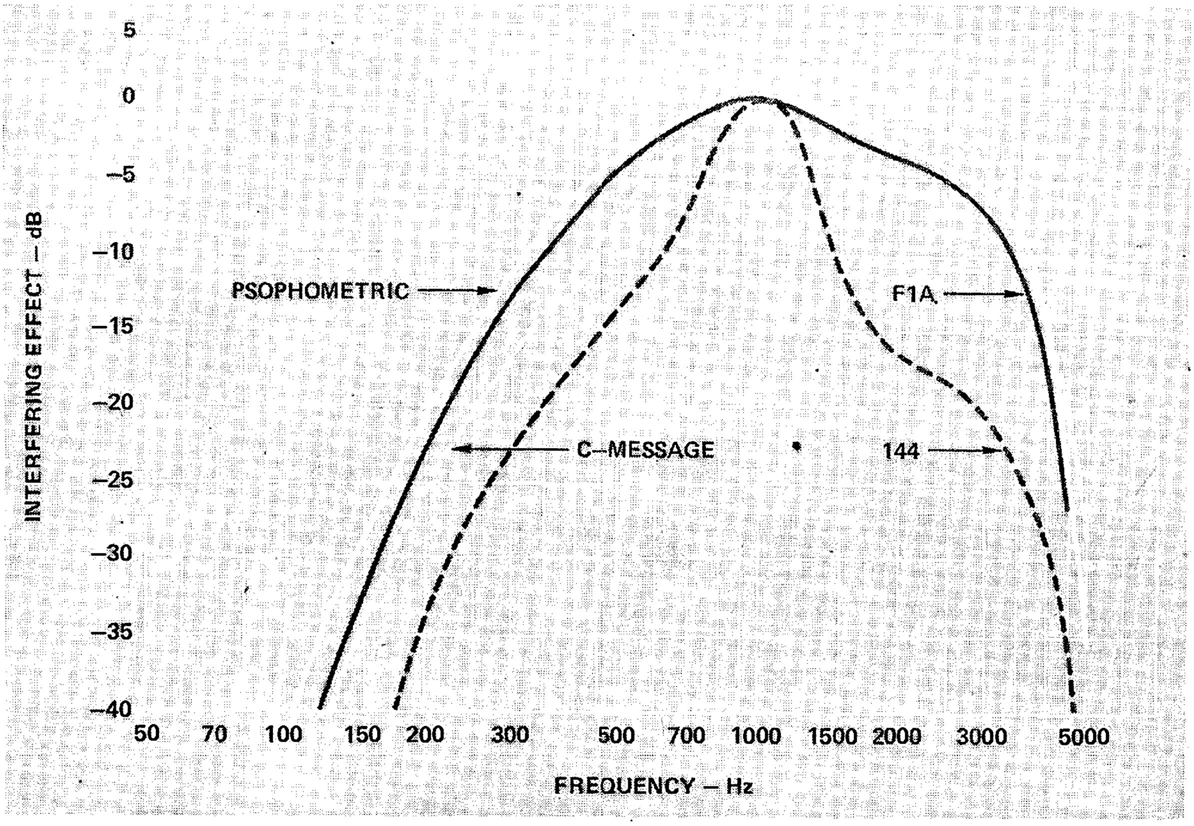


Fig. 1. Weighting curves, based on listener response shows the relative interfering effect of noise on speech.

the exponent of the base number separately, another useful shorthand is achieved, called *logarithms*. In $100 = 10^2$, the logarithm of 100 is two. That is, the common logarithm (abbreviated $\log_{10}$, or just log) is the power to which the base ten must be raised to produce the number. The written form is $\log 100 = 2$.

The use of logarithms simplifies many forms of complicated calculations. Remember that to multiply like numbers (the number ten is used here to relate to common logs), it is only necessary to *add* their exponents ($10^2 \times 10^3 = 10^5$); to divide, subtract exponents ($10^5 \div 10^3 = 10^2$). Logarithms are used in the same way. Multiplications and divisions involving large numbers may be carried out by adding or subtracting in the corresponding logs. In fact, any series of events involving multiplication or division, if expressed logarithmically, may be handled by addition or subtraction. This is particularly valuable in two-way communications, where a variety of measurements is necessary to describe the qualities of a signal as it passes through the system. Voltages, currents, and powers are measured; noise identified; and losses assessed. These are all made easier by the use of the logarithmic yardstick.

Decibels

The basic logarithmic yardstick in communications is the decibel, derived from the less practical unit, the bel, named in honor of Alexander Graham Bell. A decibel is a tenth of a bel.

Table I. Power-Decibel Relationships

Decibels	Power Ratio
1	1.259
2	1.585
3	1.995
4	2.512
5	3.162
6	3.981
7	5.012
8	6.310
9	7.943
10	10.0
20	100.0
30	1000.0
40	10,000.0

Table II. International Standards of Measurement

Measure	SI Unit	Derived Units
Length	meter (m)	area — — (m^2) volume — — (m^3)
Time	second (s)	frequency — — hertz (H)
Mass	kilogram (kg)	
Temperature	kelvin (K)	
Electric Current	ampere (a)	

Table III. International Prefixes and Definitions

Prefix	Symbol	Multiplier
tera	T	1,000,000,000,000 = 10^{12}
giga	G	1,000,000,000 = 10^9
mega	M	1,000,000 = 10^6
kilo	k	1,000 = 10^3
hecto	h	100 = 10^2
deka	da	10 = 10^1
deci	d	0.1 = 10^{-1}
centi	c	0.01 = 10^{-2}
milli	m	0.001 = 10^{-3}
micro	μ	0.000 001 = 10^{-6}
nano	n	0.000 000 001 = 10^{-9}
pico	p	0.000 000 000 001 = 10^{-12}
femto	f	0.000 000 000 000 001 = 10^{-15}
atto	a	0.000 000 000 000 000 001 = 10^{-18}

Table IV. SI-to-U.S. Conversion Factors

American Units	SI Equivalents
inches x 25.4	= millimeters
feet x 0.3848	= meters
miles x 1.61	= kilometers
pounds x 0.454	= kilograms
inches	= millimeters x .0394
feet	= meters x 3.28
miles	= kilometers x 0.621
pounds	= kilograms x 2.21

Early experimentation proved that a listener cannot give a reliable estimate of the absolute loudness of a sound. But he can distinguish between the loudness of two different sounds. However, the ear's sensitivity to a change in sound power follows a logarithmic rather than a linear scale, and the decibel (dB) has become the unit of measure of this change. The relationship between any two power values can be calculated in decibels as:

$$dB = 10 \log \frac{P_1}{P_2}$$

If P_2 is larger than P_1 the dB value will be negative; therefore, it is convenient to designate P_1 as the larger power.

It should be emphasized that a given number of decibels is always the relationship between two powers, and not the absolute power value itself (Table I). For cxample, the gain in an amplifier, or the attenuation of a pad, can be expressed in decibels without knowledge of the input or output power of the device – just the change.

dBm

Frequently, however, it is convenient to represent *absolute* power with a logarithmic unit. One milliwatt (usually into a 600Ω line) is generally accepted as the standard reference for such purposes in the telephone industry, and signal powers can be written as being so many dB above or below this reference power. When this is done, the unit becomes dBm, in the expression:

$$dBm = 10 \log \frac{P_1}{P_2}$$

where P_2 is 1 mW (10^{-3} watts).

By adding a definite reference point, dBm becomes a measurement of absolute power rather than just a ratio; and can readily be converted to watts. A measurement of 10 dBm indicates a signal ten times greater than 1 mW, or 10 mW; 20 dBm is 200 times greater than 1 mW, or 100 mW. A 15 dBm signal applied to an amplifier with a 10 dB gain will result in a 25 dBm output. Or, a standard test tone (0 dBm) will be measured as -15 dBm after passing through an attenuator of 15 dB.

It is important to note at this point that most meters used in the telephone industry are calibrated for measurements of voltage appearing across a 600Ω termination (standard transmission line impedance). If the circuit to be measured is of a different impedance than that for which the meter was calibrated, the indicated power level will be wrong, and a correction factor must be taken into account. Using the relationship of $P = E^2/R$, the following correction factor is formulated:

$$dB = dB_{(indicated)} + 10 \log \frac{600 \text{ ohms}}{\text{circuit impedance}}.$$

For example, a +6 dB reading across a 500Ω line is calculated:

$$\begin{aligned} dB &= 6 + 10 \log \frac{600}{500} \\ &= 6 + 10 \log 1.2 \\ &= 6 + 0.792 \\ &= 6.792 \text{ dB}. \end{aligned}$$

Level Point

In most telephone systems, the toll switchboard is defined as the "zero-transmission-level point" (TLP), and the levels of both signal and noise at other parts of the system are usually referred to that point. A point in the transmission system where a signal has experienced a 16 dB attenuation relative to the toll switchboard is known as the -16 dB level point. Note that *level* used this way is purely relative and has nothing to do with actual power – a signal of any power will be down 16 dB at the -16 dB level point. When a standard test tone is transmitted over the circuit, its power in dBm at any point is numerically equal to the level in dB at that point.

dBmØ

Another term, dBmØ is used to refer measured power back to Ø TLP, and has useful significance in system planning. Measurements adjusted to dBmØ indicate what the power would have been, had it been measured at Ø TLP. For example, a tone measured at the -16 dB level point with a meter reading of +8 dBm, is equal to +24 dBmØ.

In addition to dBm, there are a number of other logarithmic units used in the telephone industry which are expressed as dB above or below some reference power. One of the most common of these is dBrnc, used in the measurement of noise.

Noise Measurement

The Bell Telephone Laboratories and the Edison Electrical Insttute did original research to determine the transmission

impairment caused by noise interfering with speech. A large number of listening tests were made with different tones introduced as interference. The degree of interference was determined by comparing the power of each interfering tone with the power of a 1 kHz tone that created the same degree of interference.

A power of 10^{-12} watts) was introduced. This also necessitated a change in the units, resulting in the adoption of dBa (decibels adjusted).

dBrnc

When the new 500-type handset was put into service in the 1950s, another line weighting was introduced, called C-message weighting. Since the new equipment was an improvement over the old, an even higher reference power would have been required to express equal interfering effects with equal numbers. But this might have resulted in some unrealistic "negative" values of noise interference. So the reference power was returned to -90 dBm, and the units dBrnc, meaning decibles, reference noise C-message weighted.

Weighting curves (Fig. 1) for each handset compare interfering effects for various frequencies and are referred to as interference of 1 kHz. Noise measuring sets are frequency weighted in the same way so that meter readings obtained are meaningful in terms of what the ear detects. That is, the instrument does not measure noise intensity alone, but takes into account the frequency of the noise and how the particular frequency affects the ear.

Since there is no weighting effect on a 1 kHz tone, straightforward conversion between dBa and dBrnc is possible by comparing reference power. A 1 kHz signal having a power of Ø dBm yields 90 dBrnc. But, because wieghting networks attenuate other frequencies differently, a uniform 3 kHz band of noise (flat or white noise) will not be measured the same as a 1 kHz tone. White noise at Ø dBm will produce a noise reading of 82 dBa and 88 dBrnc. Approximate conversion is then accomplished by adding 6 dB to the dBa value:

$$dBrnc = dBa\ 3\ 6.$$

For instance, using an instrument F1A weighted, a reading of 20 dB a would be equivalent to 26 dBrnc. The conversion factor is due to the 5 dB difference in noise reference power and an approximate 1 dB difference in weighting over the voice band.

At present, dBrnc is more convenient to use than dBa.

Psophometric Weighting

Circuit noise expressed in units established by the CCITT (International Telegraph and Telephone Consultative Committee) is gaining recognition throughout the world. This international unit is linear rather than logarithmic and is in terms of picowatts (10^{-12} watts) of power, psopho metrically weighted (pWp). (Psophometric is from the Greek word psophos, meaning noise.)

The reference level, 1 pWp, is the equivalent of an 800 Hz tone with a power of -90 dBm, or a 3 kHz band of white noise with a power of approximately -88 dBm. The shape of the psophometric curve is essentially identical to the F1A curve and similar to the C-message curve. Approximate conversion may be made as follows:

$$dBrnc = 10 \log pWp.$$

Note that these terms all have absolute reference values of 10^{-12} watts, and are customarily written dBrncØ and pWpØ to relate the measurement to Ø TLP.

Signal-to-Noise

Occasionally the term signal-to-noise ratio (S/N) is encountered. The term, usually expressed in dB, indicates the number of dB the signal is above the noise. To obtain dBrncØ from S/N, it is only necessary to calculate how many dB the signal is above the reference noise power. The corrected reference (as mentioned previously for 3 kHz white noise) is -88 dBm for flat noise channels. Conversions are therefore:

$$dBrnc\emptyset = 88 - S/N$$
$$S/N = 88 - dBrnc\emptyset$$
$$S/N = 88 - 10 \log pWp\emptyset$$

When it is necessary to measure speech or program volume in a transmission sys-

tem, a dB meter or voltmeter is not adequate. The complexity of the program signal, as compared to pure sine waves, will cause the meter needle to move erratically, trying to follow every fluctuation in power. This would obviously be difficult to read, and has no worthwhile meaning.

Volume Units

To provide a standardized system of indicating volume, a special instrument was created. Called a VU meter, it measures *volume units*, abbreviated VU. The VU meter is calibrated to read Ø across a 600Ω line with a signal of 1 mW (Ø dB) at 1 kHz. The scale is logarithmic and reads VU above and below this zero reference. The instrument is not frequency weighted in any way, and while not designated for the purpose, it will read single frequencies directly in dBm. Its prime function, however, is to indicate the volume of complex signals in a way corresponding to the response of the ear. The reading is not instantaneous, but a value somewhere between the average and the peak value of the complex wave due to the meter's damping characteristic.

Other units

Various other logarithmic units are used in the telephone and communications industries to conveniently compare like values. Crosstalk coupling in telephone circuits is indicated in dBx, or dB above reference coupling, and may be measured with a noise measuring set such as used to obtain dBrnc. Reference coupling is defined as the difference between 90 dB loss and the actual coupling. Two circuits having a coupling of -40 dB could be said to have a coupling of 50 dBx.

Decibels may take on many other absolute values depending on their reference. Whereas dBm is a unit of power referenced to 1 mW, dBW (referenced to 1W) is equal to 30 dBm. Similarly, dBk are decibles referenced to 1 kW.

Likewise, dBV for industrial use is defined referencing 1V. However, in writing the equation for such a measurement, it is necessary to observe the following relationship:

$$dBV = 20 \log \frac{E_1}{E_2}$$

where E_2 equals 1V. The log of the voltage ratios is multiplied by 20, rather than 10 as in the power ratios, expressing the squared relationship of voltage and power ($P = E^2/R$). It is assumed that all measurements are across the same impedance.

Another form of decibel unit related to voltage is referred to as dBV/600 and is read directly from a dBm-voltmeter calibrated at an impedance of 600Ω.

Speech energy is commonly rated in terms of the intensity level of the speaker's voice measured 1 meter from his mouth. The standard Reference Acoustical Power, Ø dBrap, is defined as 10^{-16} watts/cm^2.

Other terms come into use in broadcasting: dBμ, with 1 mV (10^{-6} volts) as the reference, and dBj, referred to 1000 mV (1(10^{-3} volts). Both are measurements of signal intensity or receiver sensitivity. Any number of logarithmic units could be devised to suit special purposes, using decibels referred to some standard unit of power – voltage or current.

As the need for different calibrations and reference points arise, new yardsticks will be defined for ease of calculation.

Absolute Quantity

The yardstick adopted by the communications industry to measure absolute quantities is really a meterstick divided into centimeters instead of inches. The metric scale is part of the SI (international standards) units used to simplify and clarify numerical communication between countires.

The basic SI units and their abbreviations are shown in Table II. The prefixes shown in Table III are added to these basic units to indicate the magnitude.

Since some English units are still prevalent and at times more familiar, conversion factors are offered to ease the transition to SI units. Table IV gives conversion factors for the two systems.

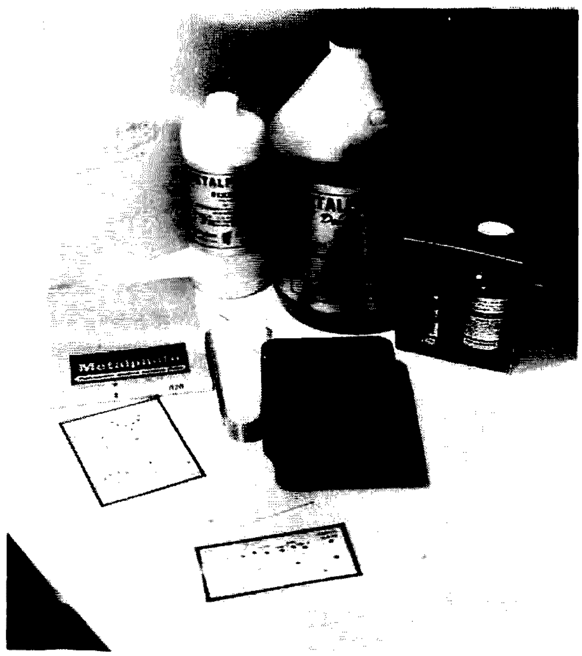
The equipment needed to provide worldwide communication is available and by adopting SI units the needed language is also provided.

Metalphoto Your Nameplate

Ed Marriner W6BLZ
528 Colima St.
La Jolla, CA

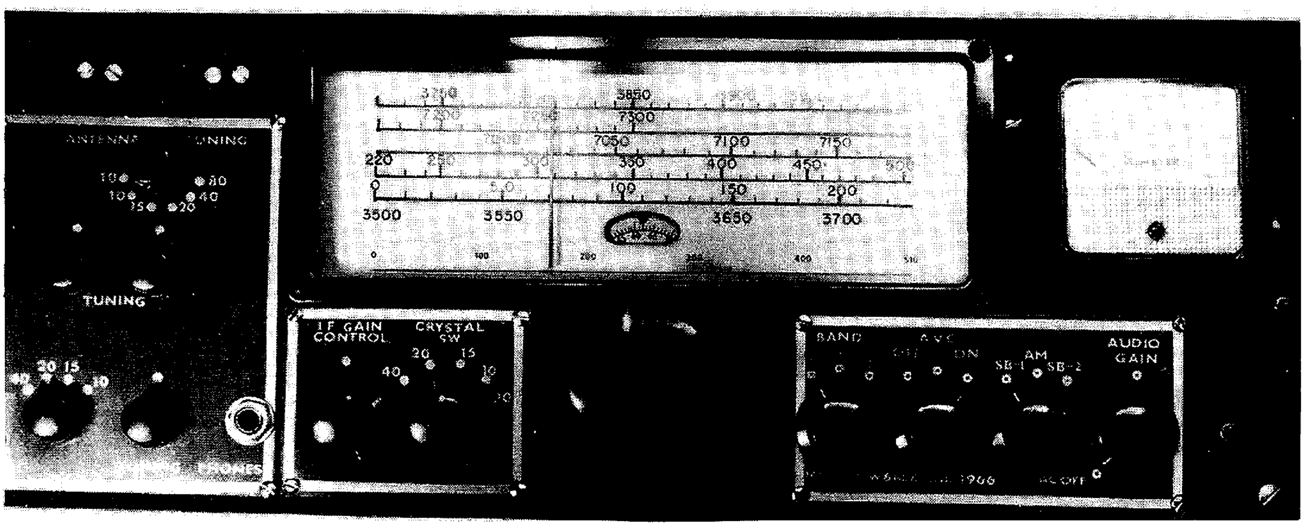
Thirty years ago you could walk into any radio parts store and buy little metal nameplates for marking home-made gear. This is no longer true. The plates have been off the market for years. Amateurs building equipment now have the choice of using decals or wax press-on letters, neither of which are very satisfactory for professional looking equipment. There is another way to label equipment, and that is by making Metalphoto nameplates. Amateurs seeing the nice results would like to make their plates but become frustrated when trying to purchase the material after hearing the store clerk quote the price. More amateurs should know about the metalphoto *trial kit* offerred by Metalphoto Corp., 18531 South Miles Road, Cleveland, Ohio 44128 which sells for $10.

What is metalphoto and what can you do with it? First, metalphoto plates are photosensitive anodized aluminum plates which can be converted into a nameplate, a dial or a schematic. To make the plate, a simple negative and standard photographic chemicals and techniques are used, and it will produce a permanent photographic reproduction. The image will be locked in a clear, glass-like, sapphire-hard, anodized layer when finished. Because of this layer, nameplates made from Metalphoto will withstand corrosive and abrasive attacks which would deface or destroy most other similar products. The whole process can be done with a few essential pieces of darkroom equipment. Actually all that is necessary is a floodlamp type P2 if a contact printer box is not available. The negative made from tracing paper is placed on top of the sensitive metal film, exposed and developed.



A negative can be very simply made on tracing paper which has been lettered with black ink, or wax art letters pressed on to the paper. Borders can be made from black printed circuit tape. This type of negative will make a nameplate having aluminum letters with a black background. For black letters on an aluminum background, a Kodalith film negative will have to be made from the tracing paper negative.

This process may seem like a lot of work, but it is fun, and how else can you obtain a decent panel? Wax letters and decals eventualy wear off, while Metalphoto will last



forever and is impervious to salt spray, organic solvents and lubricants, scratching, cracking, crazing and peeling, fading, mold, temperature extremes and repeated scourings. Are you sold? Let's get on with it.

Here is what you get in a No. 10 trial kit:

12 4 x 5 inch sensitized metal plates.
3 1 x 5 inch test plates.
1 Bottle of Chemical Image Toner (1 qt.) CT-100
1 Bottle of Developer. DM-44 (1 qt.)
1 Bottle of Fixer. FM-1 (1 qt.)

The distilled water necessary for mixing can be obtained in a grocery store.

How do you start?

First make a negative, and the best way is to draw it on K&E Transparent Sketching Pad Paper #355-11. Draw in pencil, a square the size of the nameplate. Inside this line, stick some 1/16 or 1/8 inch black tape for a border. This tape can be obtained in a radio parts store under the name ACS Tapes, Inc., and it comes in a little plastic container. At the same time buy some little black round pieces of tape used for making printed circuits. These are nice for making round corners on the borders and for making dial calibrations. Once the border is outlined, start laying in the lettering. The best way is to use wax press-on art letters which come in all shapes and sizes at any artist supply paint store. A LeRoy inking set could be used.

Once having decided on which negative to use, the next stop in the process is to lay the negative on top of the sensitized metal, and place a piece of glass over it to hold it in place. *Do this in a dark room with only a red lamp,* or the film will be exposed and ruined. When you are ready to expose the film, hold a flood lamp about 2 feet away and snap it on and off, fast as possible, for less than one second. Now place the metal film in the DM-44-4 developer for a period of 3 to 6 minutes. After a few minutes the printing should come out clear. If the plate has been over exposed the border will be sharp but the letters will be faded and dull. Very little light is necessary to expose. Remove the film from the developer and wash in clean water for one minute. The film now has to be fixed and is now placed in the FM-1-4 fixer for several minutes, taken out and washed for five minutes. Now place the metal film in the CT-100 toner solution for five minutes. After this operation the film is washed again and placed in a pan on the stove and boiled for at least five minutes to set the surface. A special solution called SA-200 can be used to give it a more glossy finished surface, but this solution does not come with the kit. After boiling, wash and dry, then polish the plate with furniture polish to give it a high gloss finish. Aluminum or chrome polish can also be used to shine the plates.

Further information and complete instructions come with each kit, and a special processing book can be obtained from the factory.

If you are building a nice piece of ham gear, it is worth the effort to make a little more investment and have it look professional by using Metalphoto nameplates.

. . . W6BLZ

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Fishkill, NY 12524

Amateur Radio and the Disabled

The typical amateur radio magazine contains article after article devoted to the care and feeding of the amateur operator and his hobby. Almost any able-bodied ham armed with a soldering iron, supplied by a junk box, fortified with the spirit of a true adventurer and guided by a well written article can homebrew at least something of usefulness.

But what of the physically disabled ham who cannot hold a pair of pliers, see the intricate workings of a circuit diagram or construct a beam, a boom, or a balun? To him, some of the pleasures of amateur radio are unachievable. Luckily, however, there are still many avenues open to the disabled who wish to take an active interest in amateur radio. For such people this article is mainly written.

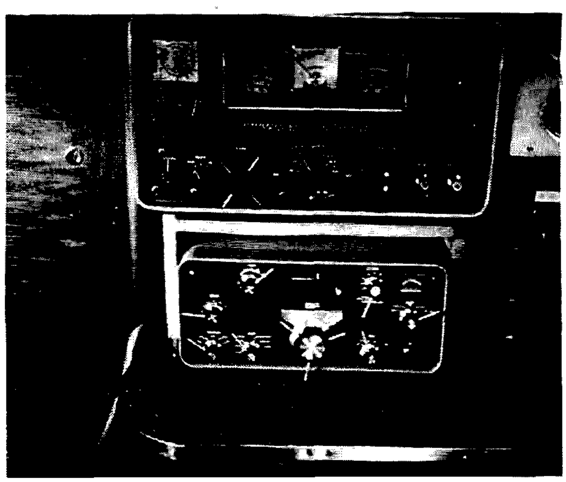
In August of 1960, due to a freak diving accident, I became physically disabled. Medically my condition is known as "quadriplegia." In lay terms this is a semi- to complete paralysis of the arms and legs, brought about by severe injury to the spinal cord.

After a year of hospitalization and rehabilitation, I returned home. I completed my senior year of high school, graduated, and began college extension courses. Today, I get around in a battery-powered wheelchair and live a near-normal, though handicapped, life.

The amateur radio "bug" struck on Christmas of 1966. Interest in the local fire company instigated the purchase of an FM receiver. Listening to all of the activity quickly led to investigations into the world of CB. Needless to say, my hopes were soon utterly smashed. Being down, but not out, I then contacted WA2IZO and within the length of a telephone call, I was hooked.

In February of 1967 I purchased my first ham receiver and begun studying theory and code. Three months later I took my Novice tests, WA2IZO proctoring, and received my license in August. Six months and 31 states later, I received my Conditional Class license; K2TFD was the helper this time. And on April 5th, as WA2CGA running 100 watts cw, I made my first contact in New Zealand with a 5-9-9 signal report.

Since my beginnings in amateur radio, I have had much enjoyment, a great deal of satisfaction and a few problems. Most of the difficulties were easily solved, though some took a bit of ingenuity. For instance, how do you operate a bandswitch or flip an on/off control when you lack both feeling and movement of your fingers.



All controls "pegged" for ease of operation. Distance between knobs is a factor when choosing equipment which has to be "pegged."

To solve this dilemma, my dad "pegged" all inoperable controls and switches with

lengths of metal knitting needles. My main tuning dial looks like an old ship's wheel, but by using the side of my hand, I can operate it "normally."

Another problem arose when it was necessary to change the crystals in the Novice rig. This was easily solved, however, by simply yelling "Mother!" whenever a new rock was needed.

Operation of the straight-key presented its little headaches, but none that ever required an aspirin. At first I literally pounded the key with my semi-closed hand. The old saw, "you have a good fist," was never more true. For General Class speed, however, this method soon proved unsatisfactory. I tried numerous types of paddles and extenders and even thought of trying a mouth-type arrangement, but nothing worked. Eventually I found that with the paddle resting in the palm of my hand, I could achieve a respectable speed. Since I could not grip the paddle, I found it was necessary to move my entire arm up and down in order to compensate or substitute for the usual wrist movements. With this somewhat awkward arrangement, I increased my speed to 14 words a minute, though 10 was more comfortable and less tiring.

Keeping the key stationary while sending presented another little obstacle. I did not want to nail the key down, so I did the next best thing. After some searching we dug up a piece of cold-rolled steel about the size of this magazine, only an inch thicker, and weighing 9 pounds. Three carbide bits later, my dad had the key mounted to the steel block. A touch of Gun-Blu and a felt bottom completed my near-permanent key. I don't recommend this type of arrangement for mobile CW work, however, for even the ablest of hams will find it cumbersome and a real toe-crusher if dropped.

With all of the minor difficulties solved, I finally began realizing many enjoyable contacts. Each new state or DX station worked was a real achievement. Not knowing when to leave well enough alone, I soon became involved in all sorts of things, many of which I knew little or nothing about.

First, I decided to buy my own Novice transmitter, despite the fact that the one I was borrowing was more than adequate. I figured why run 60 watts when 75 would get you so much further. (Believe it or not, this was a good excuse at the time.) Later, beaming at my new, shiny rig, I soon realized I had made two major goofs. First, the transmitter, which was one of the best CW rigs on the market, had no facilities for phone operations. Thus, in a few months I would have to buy another if I wanted to work in this mode. Second, the transmitter wasn't compatible with my present receiver. Facilities for side-tone monitoring, receiver muting and a new transmit/receive setup would have to be constructed all over again. Obviously another call to WA2IZO was in order.

When I purchased my General Class transmitter, I again had to face the problems of incompatibility between it and my receiver. Luckily, I had acquired a little more knowledge on the subject and a few more ham helpers, so things were a bit easier the second time. I realize all hams have to deal with this aspect of amateur radio. For many it brings much satisfaction when a workable setup is devised. To me, however, it is something I would like to avoid since I cannot do it myself and I am forced to call on others.

A word to other disabled: (1) purchase your transmitter and receiver, if at all possible, from the same manufacturer, and (2) be sure that your rig operates either AM&CW or SSB&CW. By doing so, you will then have fewer hook-up problems and you will have secondary equipment when you buy your general class equipment.

All amateur radio operators, at one time or another, regardless of license, equipment, or code speed, are confronted with the commercial broadcast interference syndrome; affectionately known as "TVI." In fact, no amateur is really an amateur until he has been officially baptized by his first irate telephone call and has encouraged the sale of a high-pass filter. Moreover, hams should be entitled, in my opinion, to commissions for their part in the sale of such filters and receive a percentage of the customer installment fees on local CATV systems.

Since my disability is fairly well known in the neighborhood, some of my TVI pains were/are somewhat different than the usual.

In one instance, where I was actually at fault, certain neighbors remained silent when they should have spoken up. I suppose they assumed I had few activities and thus didn't want to limit my new-found hobby. My ground system had deteriorated to a point where 15-meter harmonics were affecting certain TV receivers up to 300 yards away from my antenna.

In other instances, however, when I was not at fault, the usual calls and inquiries were registered in the usual calm and diplomatic manner associated with the avid TV fan who is positive some ham is personally interfering with his reception. It seems that the mere physical presence of the tower and quad antenna, regardless of whether I was on the air or not, or even home, instigated many of the complaints; operating times in the log and cold tubes notwithstanding.

To the disabled, then, let me again state a few things: (1) see that all equipment is well grounded and filtered, and(2) be sure, above all else, that you are not interfering with your own television reception before operating on the air. Once this is done, you can be quite certain that you are not bothering the thoughtful neighbors and not giving "ammunition" to those who do not understand the numerous caused of non-ham-made interference. Your disability should never be an excuse for a bad signal or for improper operating procedures.

WA2CGA's complete station. All equipment easily reached without moving around. Homebrew table allows access by wheelchair.

Finally, I cannot end this article without fully endorsing amateur radio as an excellent hobby for the physically disabled. Nor can I begin to thank the many hams—WA2IZO, K2TFD, and W2VAQ to name a few, who have helped out so many times, or my dad for all his hours spent on the roof, in the shack, or at the neighbors.

I hope more physically handicapped individuals will become amateur radio devotees and that the hams who live near them will be as conscientious as those I have mentioned. To quote the FCC: "No physical infirmity is a bar to the issuance of amateur operator and station licenses, provided the applicant can qualify." And, as of June 17, 1968, the Federal Communications Commission will allow the examinations for *any* class of license to be taken by mail.

....WA2CGA

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Solid State Microwaves for Amateurs

Crystal controlled exciter-transmitter for the amateur S-Band, 2300 to 2450 MHz.

Since writing in 73 Magazine on "UHF Transistor Circuitry" in 1964–1965, a lot of water has gone under the bridge. That was not long ago by some measurements, but in solid-state technology it has made quite a difference. Transistors now oscillate at over 5000 MHz (yes, five thousand!). Good S-Band communication sets using crystal-controlled transmitters (this article describes one) and receivers are now feasible. Transistors whose collector circuits resonate and give power out at S-Band can be built on the kitchen table. Good tuneable local oscillator circuits at 4000 MHz are simple. Piezoelectric voltage controlled capacitors for remote tuning will work up to and including X-Band, and frequency multipliers using strapline made with nothing more than copper straps you can cut yourself will work well up into the ham S-Band.

So, you get some idea of the rate of progress. Now for hams, what does it mean? At the moment, let's concentrate on the 2300 to 2450 MHz ham band, leaving 1296 MHz far in the wake.

2300 MHZ

This is one of our bands so let's see what can be done with transistors on it today. Reasonable cost transistors work there. You can build this one with copper straps and nylon bolts; you can modulate it with good old Admirable Modulation; a superhet receiver is easy to make, and even little yagis work there, although this is the band where a 36 in. dish has over 20 dB gain. Dishes of almost any kind, have gain of 20 dB or more, so you only need a two footer for 2300 MHz.

You might as well use crystal control from the start, because it's the last doubler that costs the most and is the hardest to build, whereas the first stages are the easiest. It also can give you nice checks on the band edges!

My philosophy has always been for power doublers because, if you do it right you don't lose power as you double in frequency, and you can even gain power. And when you get where you want, like 2300 MHz in this case, you can modulate the doubler right away with a little $10 Lafayette amplifier. Of course nothing stops you from adding an rf amplifier and modulating that too.

Also included in this trend is the use of grounded emitter multiplier-amplifier circuits. If you ground (rf-wise, that is) the base you are setting up the correct base-collector out-of-phase condition for an oscillator! And most of the time that's just what will happen! In a multi-transistor rig there is always plenty of chance for spurious, so don't invite them in!

A list of tools required may be of interest. Scissors; small metal shears; Ex-acto knife; a goodly collection of small precision side-cutters, pliers, needle-nosed, thin flats, etc.; two soldering irons, one small; good set of drills and taps; bench vise; drill vise; quarter inch drill; and such meters as you may have.

48 to 50 MHz Oscillator Stage

There should be no trouble here, as plenty have been described in 73 Magazine, and we're going into real detail for a sure fire solid-state exciter, useful all the way from 50 through 144, 432 MHz, and all the way up to S-Band. Just use my patent phase-reversing circuit (the crystal does just that for you) and you can't go wrong! For the oscillator see Fig. 1A, and for test

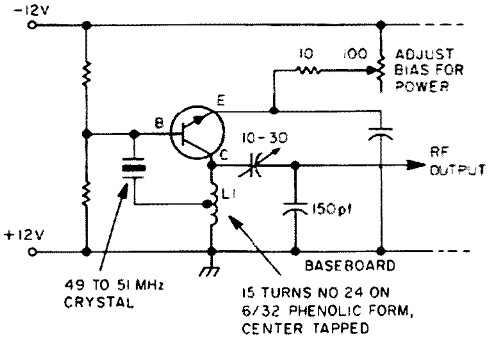


Fig. 1A. Oscillator, 50 MHz.

setup, Fig. 1B. A good trick for driving the next stage doubling circuit or amplifier is the two-capacitor impedance match to the next base input, using the smaller capacitor for tuning.

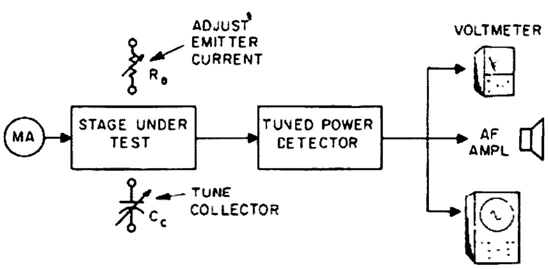


Fig. 1B. Block diagram test setup.

It tunes well, lowers the impedance to the best value, and gives dc isolation for the next base (see Fig. 2). What more could you want?

As you go up in frequency through the following stages the capacitors get smaller and smaller, but can still be managed for the three hundred MHz stage. After that you can still use capacitor tuning, but you have to make them yourself. Don't worry about them, just get in a supply of nylon nuts and bolts and away you go!

While still on the oscillator stage you might be encouraged and helped by knowing that even though my radio work goes

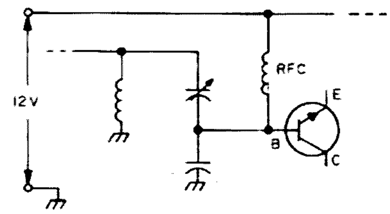


Fig. 2. Output impedance adjuster.

back to 1921 and Ford coils, with my first transistor on the air in 1953, I get stuck every once in a while.

In my past writing, it sometimes happened (many years ago), that when a standard circuit was included in an article I felt it was quicker to *assume* it would work than to try it out. I was sticking my neck out and skating on thin ice. After getting caught this way several times I stopped assuming and now I always sit down at the bench and give it a whirl first before writing about it. Just look what happened even today! Figure 3A shows the 50 MHz oscillator stage being described. It just wouldn't work, even though I was surrounded by three older ones that did. So what to do? Just write up one of the older ones? That's sticking the neck out again. I started thinking about it around 4 am and, at the bench a little later, I disconnected the dc base bias, R1 and R2, and sure enough the emitter current was still heavy. I changed transistors but still had heavy current. When the emitter bypass capacitor was unsoldered, the current vanished.

Checking through the lists of faults (mine) here they are: 1. The use of an electrolytic capacitor for bypassing at VHF. Not needed, unless to save space for microminiaturization. 2. Playing around with both PNPs and NPNs the same day. That's how I got the polarity reversed. Remember the old rule, an NPN takes

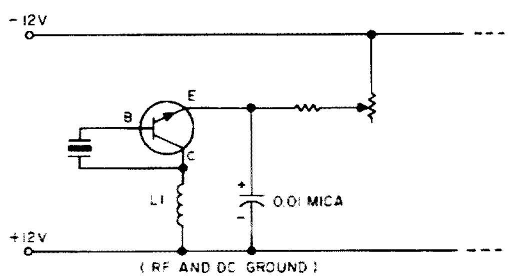


Fig. 3A. How not to do! Don't use an electrolytic. capacitor.

positive voltage to attract those negative electrons; the PNP takes negative voltage to attract those positive holes. 3. The use of grounded dc collector. This was the main item, as you can see by Fig. 3A. When you are going up into the microwaves it is handy to have the collector polarity the same as the ground plane board, so that sliding shorts work out without shorting the dc as well as the rf. But this means that the emitter bypass is now *not* across the emitter resistor as usual, but is shunted across the whole battery supply, through R3 and R4. No trouble here if that electrolytic capacitor is connected right. Use molded mica anyway, it's better as you go up through VHF.

Further Oscillator Details

As long as the circuit was laid open on the bench, I checked on the possibilities of a two-terminal oscillator coil, as shown in Fig. 3B, and found that, while it can be made to work, I was better off to use the tapped coil. See Fig. 1 again.

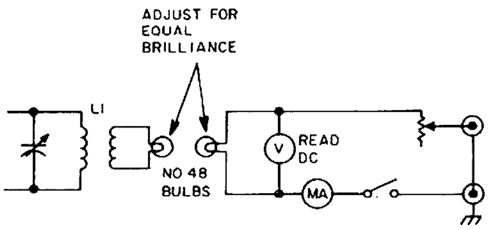


Fig. 3B. "Poor man's milliwattmeter."

Just for fun I put a pot in the battery line to see how low a voltage it would oscillate with, always a good criterion for an oscillator. The minimum was 4.6V at .3 mA, for a grand total of 1.38 mW dc input. It's a good one!

It also handles beautifully with 12V, and at 18V and 30 mA, which is over half a watt input, it puts out at least 36 mW as measured on the poor man's milliwattmeter of Fig. 3B. Running 0.8V at 45 mils dc to the number 48 bulb it shows equal brilliance. This suits me fine, because any time I've ever lit a bulb with rf, I've been able to work someone on the band. Actually of course, we don't need all of that 36 mW to drive the tripler stage coming next, but it's nice to have a little to spare. The above was using a KMC 3N2502 which is a higher frequency transistor than needed for 50 MHz. Most any good UHF device will do the trick at that frequency.

The next thing I tried was several different kinds of coils for LI because not every ham shack has the same kind of junkbox. I always start with the air-wound half-inch units because they are more or less standard for six meters. Seven turns of 16 to the inch was the coil used for the above tests. Next tried was a coil wound with #24 wire on a 6/32 threaded phenolic core,. Another bug showed up, as the attempted two-terminal coil showed trouble at this time. If the crystal terminal designated with an arrow, as shown in Fig. 3B, is soldered directly to the collector terminal, forget it! Quick like a bunny a coil with centertap was wound up, 15 turns of #24 wire on thin-wall phenolic again, a core turned in, and bang, all kinds of good, stable power returned, with perfect handling. Of course it helps to have all these little pieces in the junkbox. The accumulation of such items should be the continuous effort of all real hams. The final circuit is in Fig. 1. Before going on to 150 MHz you might note that with a 48 MHz rock and this oscillator and the following tripler, you have a nice two meter band edge spotter. And with a slightly higher one you can talk to your two meter friends.

Tripler Stage To 150 MHz

If you have to order a crystal, you could get one on 75 MHz and double to 150 instead of tripling. Lots of hams have 50 MHz rocks around, which is why I used one. A little over won't hurt because the ham S-Band goes up to 2450 MHz, in fact, you can start a little lower if you want because a 48 MHz unit comes out on 2304 MHz with the 48 multiplication used in this exciter. 2304 MHz is a little close to the lower band edge, but no trouble should arise. There are a lot of two meter band spotting crystals around at 48 MHz and some of these low-priced microwave transistors work better at 2300 MHz than they do at 2400 MHz.

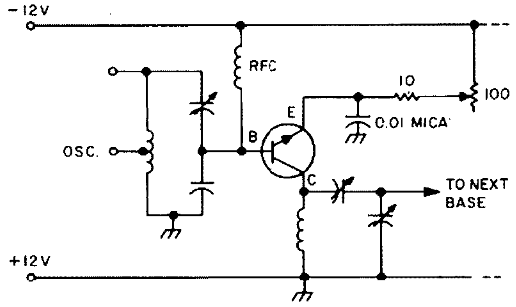


Fig. 4A. Tripler, 50–150 MHz.

Figure 4A shows the details of the tripler. Please note the simplicity. I claim it has everything you need and nothing you don't need. Anyway, it works like a charm and you should go through it and the next one like a breeze, using the test setup shown in Fig. 1B.

Avoid using too much drive. These little transistors, when used in exciters, have a nasty habit quite unlike tubes of snapping into spurious modes of operation when slightly overdriven. You can hear this while listening to the output (always a good thing anyway on general principles) or you can monitor it on a scope. It has some resemblance to superregeneration or squegging, and is *not* wanted!

Watch out also for resonance at other frequencies than 150 MHz. I always check with a tuned detector, Fig. 4B, which acts like a grid-dipper operated in the diode mode. Granted, you have to calibrate the detector first, but you must know *someone* with a signal generator. Use a coil for L1 up to around 300 MHz, and a copper strap from 300 to 1000 MHz. After that a good prayer sometimes helps!

Using the detector of Fig. 4, I found that when the dc output gets up around 5V or so, it is possible to light a No. 48 bulb if

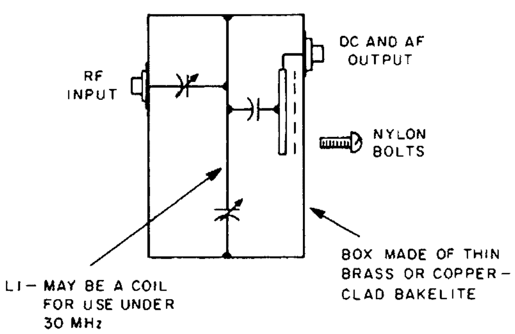


Fig. 4B. Tuned detector.

it is coupled correctly to L1 of the multiplier. This coupling must be such as not to overload the tank. Vary it to find the right amount. This stage did light the bulb, using 18V on the collector, after which I dropped it back again to 12V, which I try to standardize as being suitable for a car battery, as well as two lantern batteries.

Once again, be sure that everything handles smoothly. The emitter resistor should increase the output power, but only up to the correct amount of bias for the frequency multiplication used. L1 and C1 should tune properly, and the output impedance point between C1 and C2 should match the next stage base input.

Tripler, 150 to 300 MHz

This is practically a repetition of the first multiplier. You can still use a regular coil and capacitor and get good output on 300 MHz, but you have to pay more attention to everything you use and how you do it. Figure 5 shows the details. You can use

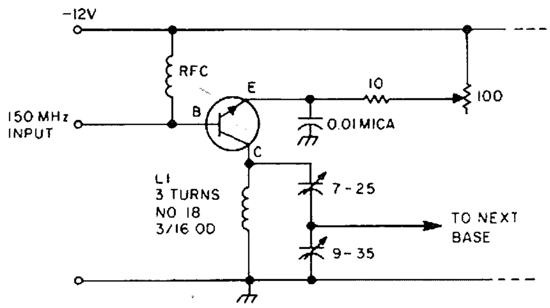


Fig. 5. Doubler, 150–300 MHz.

any good UHF transistor, like a 918, 2N3600, etc., or the UHF TV plastic jobs can be had for 39¢. Of course use a wavemeter or grid-dipper of what have you, to be sure you're on 300 MHz. Also, a tuned power detector will help find the frequency for multiplying (A). A simplified schematic is shown in Fig. 4B. A one turn link around the collector coil L1 coupled by an rf cable over to another one-turn link around the grid-dipper coil will do the trick. Once again, the midpoint of capacitor C1 and the larger capacitor C2 should be matched to the next doubler stage base input, and what better method than to use the next stage as an rf voltmeter? As the next base has no dc bias on it except that

which is generated internally under the rf action of the preceding stage, the collector current will be zero until rf arrives on the base. This base drive will cause collector current to show, indicating the desired amount of input needed.

This stage can now be tuned up using the next one as an indicator of collector resonance. Don't forget that most any type of transistor can burn out the base-emitter diode of its brother type following! Figure 5 shows details. I tried a number of collector inductors just to see and there is not much difference in the results when everything is matched and running right. Just be sure and check that frequency for 300 mHz! I hit the tripling spot of 450 MHz several times while tuning up and testing various resonators. The rf chokes are not too critical – I use 30 turns of fine wire, like numbers 34 to 38, double silk covered, wound up in two sections on a small form or a tenth watt resistor of around 1 MΩ. C1 and C2 for this stage are as small as you can get in size, but are not too critical. Do *not* use lead wires at all! Use the setup shown in Fig. 1B, and use an af amplifier on the detector to listen for lf oscillations, spurious radiation, superregeneration, squeals, and other various nuisances. A scope is good too, as it will show oscillations above audible frequencies.

Doubler, 300 to 600 MHz

Cheer up, only three more to go! Really worthwhile things are not built in a day. On this one, for 600 MHz, you can go to a small cavity just for practice even if it's a square one (actually oblong). You could

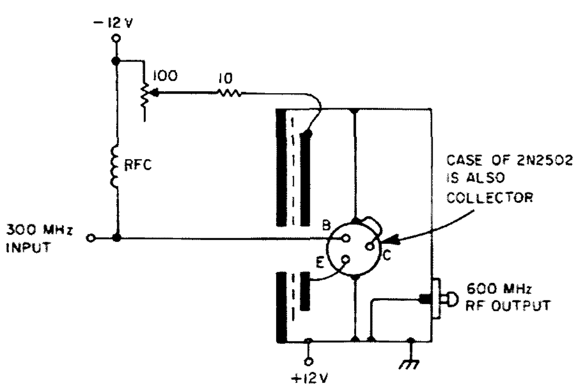


Fig. 6A. Doubler, 300–600 MHz.

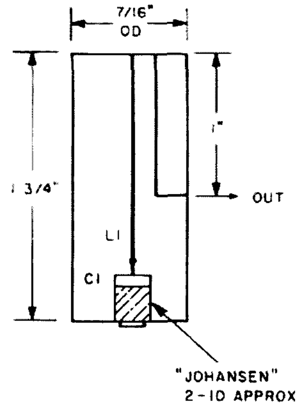


Fig. 6B. Box-cavity dimensions.

use the strapline techniques of the next two multipliers, but it doesn't hurt to try different styles once in a while. By using good UHF principles, this stage worked beautifully the first time and hit 600 MHz with good stable output. Note that you've gone right by 432 MHz which you can whip up with one hand after doing this S-Bander.

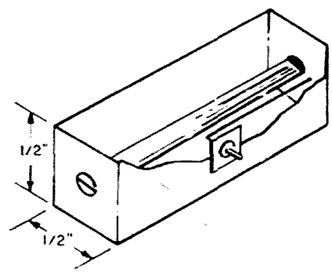


Fig. 6C. Sketch, 600 MHz cavity.

Figure 6A shows the pictorial schematic, Fig. 6B some dimensions, and Fig. 4C shows a sketch of the cavity without Ce, the emitter capacitor. Ce is formed by a thin brass strap or plate, 1¼ in. long by 7/16 in. wide, bolted to the inside of the cavity with nylon bolts and a three mil piece of fiberglass or mica sheet in between.

Cut a hole for the base lead of Q1 in both the cavity wall and the Ce plate before bolting. The emitter dc lead can be taken out of the cavity through a small hole in its wall. Re is the usual 100Ω pot with a 10Ω limiting resistor added on. I always start with a variable emitter resistor and then, when the whole rig is adjusted for good power, tuning, and proper handling, the variable pot can be removed and a fixed value substituted. The proper value

for the fixed Re can vary somewhat as to the device used for Q1, and various other parameters of the circuit.

Once again of course, watch those frequencies. You're getting up there now and it's easy to hit the unwanted ones. Another thing I haven't mentioned yet is that a lower frequency like 50, or maybe 150 MHz, will sneak through and you'll find yourself on 450 or 500 MHz instead of 600 MHz, where you want to be.

Doubler, 600 to 1200 MHz

Can an ideal circuit for solid-state, easy ham construction of multipliers and amplifiers to S-Band be made? Let's try it and see. Maybe it can be done with stripline.

Good news for you! It works very well, tunes fine, even to the tripling frequency of 1800 MHz! The input, output, and transistor impedance can be matched and there are three variable capacitors to do it with, all built-in and homemade of spring-brass or copper strap. See Fig. 7A. You do

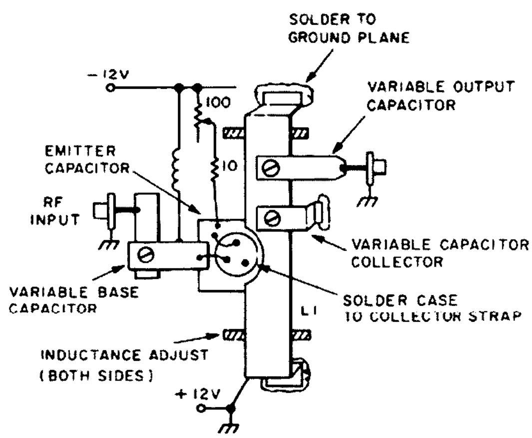


Fig. 7A. Strapline doubler, 600–1200 MHz.

have to use nylon bolts, but after all, this is 1200 MHz, the beginning of microwaves. You need some spring copper also (I think it's beryllium copper I'm using).

See also the regular schematic, Fig. 7B, which does show the circuit but not the shape, which is of course always important from UHF on up. So alright, let's get into the meat of it.

Having made straps over ground planes work at 4000 MHz and even at X-Band on occasion, I figured I could do it with the strap-type of construction, at least as long

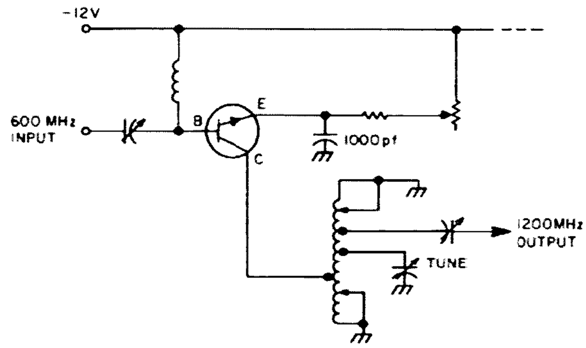


Fig. 7B. "Regular" schematic, 600–1200 MHz doubler.

as my supply of nylon nuts and bolts held out. If you order some you probably should get some fours and twos, as the number sixes I'm using are rather large for the little capacitors being made.

Stripline, as practiced commercially, uses thin copper plating over an insulating sheet over a ground plane. This is hard to cut up properly on the bench, difficult to make into tuned lines, and does not lend itself to variable inductance circuits or variable capacitor construction. The method described here avoids all these difficulties. We start with the ground plane, copper clad Bakelite or surplus copper clad fiberglass as I happen to have here, but we are not going to cut it, etch it, or do anything except solder to it, which is extremely easy.

The base input variable capacitor should be made because you cannot buy them, except very expensive ones which are not as handy or as good as you can make.

Referring to Fig. 7C, a copper strap 1 in. long x 3/8 in. wide is soldered to the input connector and bolted to the ground plane with a nylon bolt and two nylon nuts, one between used as a spacer, and one underneath to fasten it to the ground plane which happened to be 4½ in. square.

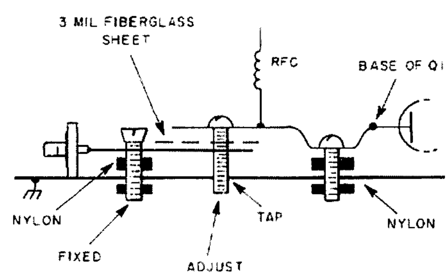


Fig. 7C. Variable capacitor, base input.

The second strap is of spring copper sheet 1¼ in. long x 3/8 in. wide, not critical, and one end is bolted (always with nylon bolts) away from the ground plane and the other end with three mil fiberglass or mica in between goes over the top of the first piece, and a nylon bolt tapped into the ground plane serves to change the capacity by varying the distance between the two straps. This distance varies from three mils to about 1/16 in. For convenience the ground plane is held up off the bench by four 3/8 in. long 6/32 bolts, one in each corner, which provides space underneath for the protruding nuts and bolts of nylon.

Note that the above mentioned capacitor also forms the strapline connection between the input connector and the base of Q1. That it works fine is proved by the milliamperes in the collector of Q1, which go easily to 20 or over, from the 600 MHz doubler driving it. There is no assumption here of a perfect match, which could involve a lot of more expensive equipment. It is only a question of "does it work?", and it does!

The emitter capacitor is also homemade for the same reason; you can't buy one! It is just a thin brass plate, perhaps .022 in. thick, ½ x ¾ in., and nylon bolted to the ground plane with a three mil insulating sheet between. Smooth and polish both metal surfaces to avoid puncturing that thin sheet.

Q1 is soldered, wires down, to the base input strap which also forms the input connector, and also to the emitter capacitor. These leads should be no more than 1/8 in. long, preferably less. The collector is soldered to the collector strap itself, using a small iron and the least amount of heat possible.

The main item comes next which is of course the half-wave collector circuit. It is made of brass strap 4 in. long by ½ in. wide, bent down and soldered to the ground plane at each end, air-spaced about 3/16 in. from the ground plane. Figure 7D shows a side view of this item.

The sliding shorts are simply pieces of thin spring copper bent as shown in Fig. 7D. They work surprisingly well, considering their simplicity of construction. They

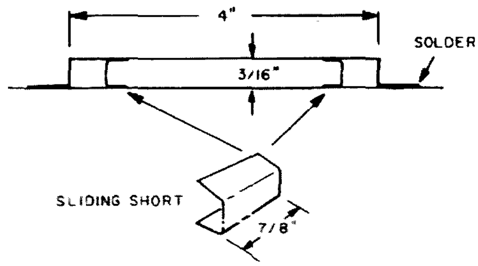


Fig. 7D. Half-wave collector resonator, side-view.

serve to set up the approximate frequency, which is then tuned precisely with C2. I was able to move them along to tune up even to the tripling frequency of 1800 MHz (not used in this stage) with about 1¼ in. between shorts.

Figure 7E shows the rf voltage distribution along the collector inductance LI. This can be checked by an rf probe, or even by the old reliable pencil test, which should show maximum detuning at the center when touched with a lead pencil tip,

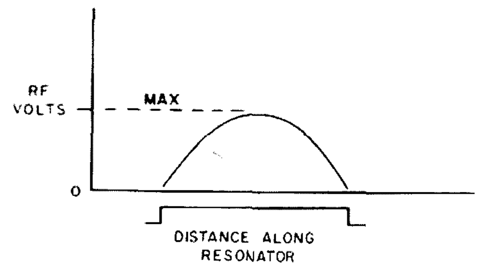


Fig. 7E. PF voltage distribution along half-wave collector circuit.

while watching an rf indicator at the output. It is important that the voltage standing on the strap should be as shown, otherwise you may not be on the proper frequency at all. Note that this is essentially two quarter waves front to front.

Capacity tuning is accomplished by sliding shorts as in Fig. 7F. You will find it very convenient to sit back, after lining up the inductive tuning, and peak up the output with a turn or so of that nylon bolt.

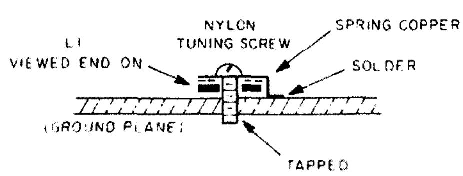


Fig. 7F. L1 collector resonator tuning capacitor.

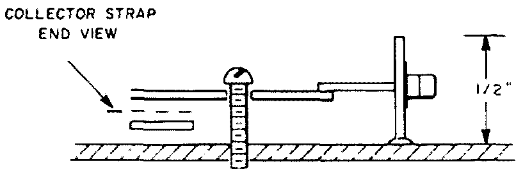


Fig. 7G. Output connection.

The output connector and cable matching capacitor is another spring tab, 3/8 in. wide by 3/4 in. long, soldered to the output connector and adjusted by a nylon bolt, cleared through the tab and tapped into the ground plane with a three mil sheet of fiberglass between as usual.

Tuneup

Applying the 600 MHz input to the base, and 12V on the collector, as per Figs. 7A and 7B, a rise in current from near or at zero should be observed. I usually put the milliammeter in the emitter lead between the emitter and the −12V. If you were to attempt to lift the collector inductance return from the ground and put the meter there you would of course destroy the continuity of the rf circuit, so put the meter in the emitter line as shown. This line is conveniently already off ground. As soon as some current shows, adjust it to around ten mils with Re and the input capacity to the base, and check the collector tuning for resonance at 1200 MHz. The wavelength of 1200 MHz is close to 25 centimeters, the half wave about 12½, which makes it about 5 inches. The inherent resistance of the half wave circuit to loading effects is shown by the use of a 4 in. long strap, even though the collector-emitter diode portion of the transistor is directly across the high voltage part of L1.

Checking the final length between shorts, after tuneup, I find it is exactly 3 in., showing the use of C1 tuning L1 to resonance. A good circuit should always include some capicitance for best Q. Resonance was indicated by rf at 1200 MHz on a detector circuit as in the block diagram, test setup.

By thinking this strap circuit through before building, it worked well from the start, even tuning to 1800 MHz. No changes were needed during tuneup, which is an exception to my usual work.

I still use the RCA type phono jacks for the meter circuits, with a simple shorted plug closing it when the meter moves on to the next stage.

Always use a certain amount of Re (emitter resistor) in the circuit as a frequency multiplier requires bias in order to operate correctly. While I have shown this stage as a complete circuit in itself, it can be built onto one board along with the other stages. A word of caution: certain interreactions *can* occur when everything is on one board. For the moment we will just

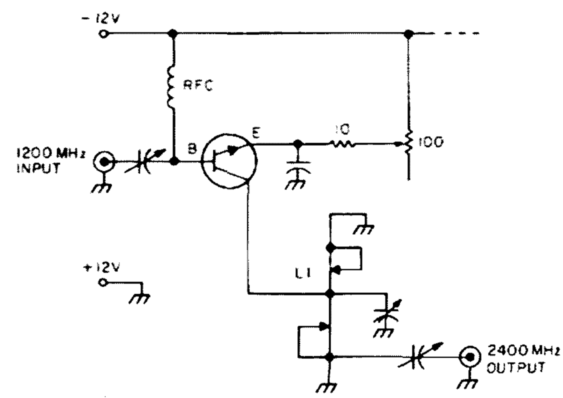


Fig. 8A. Schematic. Doubler, 1200–2400 MHz.

mount everything on a set of small shelves and try it out. We still have one more multiplier to go, which is a duplicate of this one, just smaller and shorter, for 2400 MHz.

The 1200 to 1400 MHz Doubler

It also works with strap-line. Figure 8A shows the schematic which again is almost identical with the last doubler. Figure 8B is a top view pictorial showing the scaling down used in size from the 1200 MHz unit. Smaller nylon bolts and nuts would help

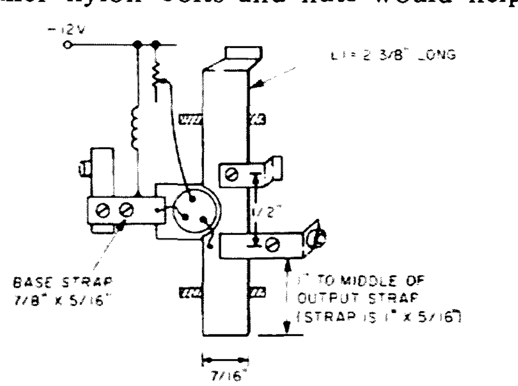
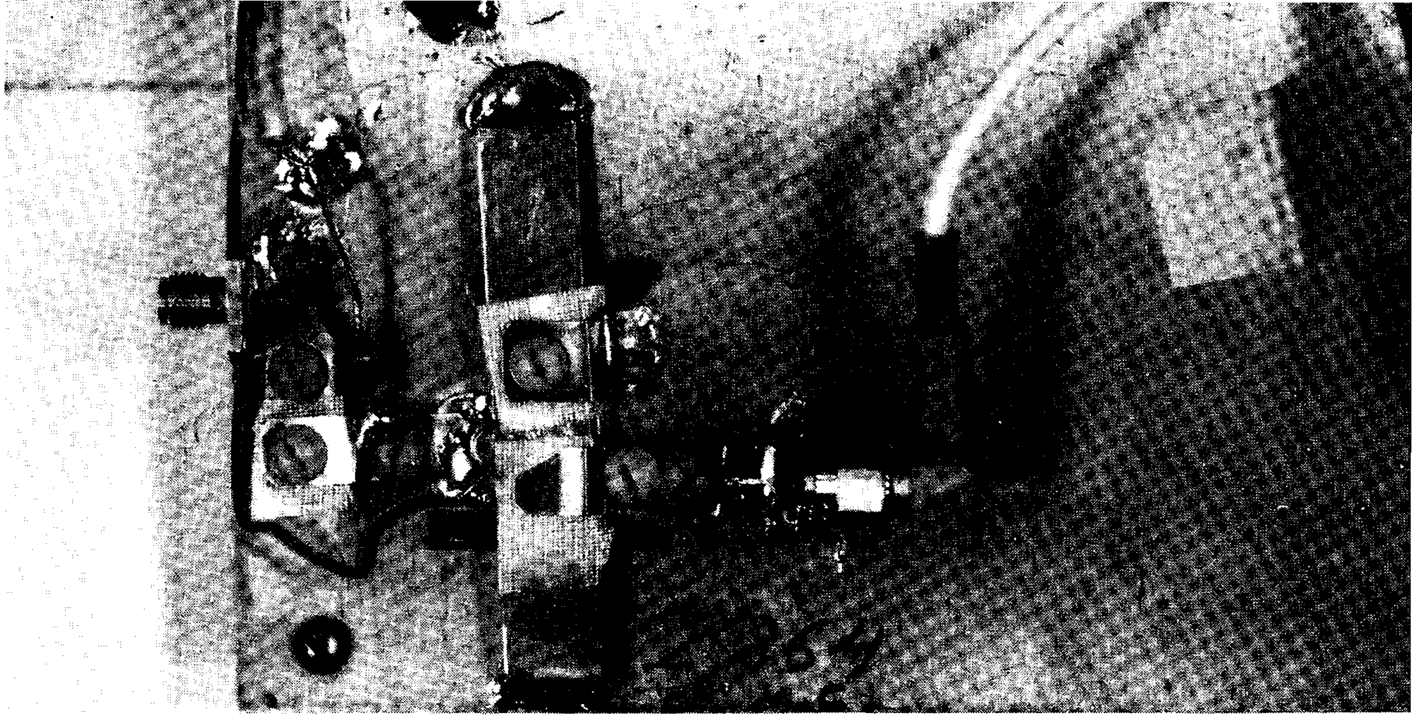


Fig. 8B. Top view. 2400 MHz.



Detail of 2364 MHz doubler.

here also as the 6/32's I'm using are pretty big for the straps used at 2400 MHz.

For this last doubler I also mounted the half-wave collector resonator closer to the ground plane, which made things such as the addition of the transistor a little more difficult, but not too. It worked out as shown in Fig. 8C. So on I went, clipping, polishing and drilling copper straps, some of the spring type for the three capacitors,

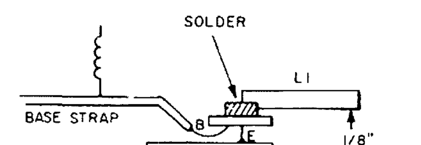


Fig. 8C. Transistor details. 2400 MHz.

tapping the baseboard for the nylon bolts making up the capacitor adjusting screws (see Fig. 8C), and soldering in the 2502, as in Fig. 8B.

Once again, be sure to smooth and polish all capacitor bypass plate surfaces, as well as the three variable ones, input to base, collector tuning, and output coupling.

True to my philosphy of using high gain power doublers as frequency multipliers, this one worked well, showing as much as 20 mA collector current from the base input drive on 1200 MHz, and even showed output at 3600 MHz (not used here) which is the tripling frequency of 1200 MHz.

The half wave resonator gets reduced at 2400 MHz, showing a total of only 1 1/8 in. between shorts. I ran them in pretty close in order to get good tuning with C2, and the resonator responded well, peaking up good and sharp on 2400 MHz.

The 2N2502 is really being pushed at this frequency. Later, an rf power amplifier using a Fairchild MT1116 will be described, with which I have already put out 100 mW at over 3000 MHz.

Incidentally, when one speaks of solid-state power at these frequencies we are talking about tens or a few hundreds of *milliwatts*, not watts.

If you have even half of the fun building this exciter that I did you can call yourself a bona fide dyed-in-the-wool ham. Why anyone would want to sit around and wait for a kit to come out when it is so easy and fun to build, is more than I can answer. All this project takes is a few simple tools and a desk top. Even the test equipment requirements are almost zero. Not bad for putting a real live signal into one of the rarest of amateur bands: 2400 MHz!

When you do duplicate my little project please send a picture of your unit to 73 so your efforts can be used to encourage others. Perhaps we can get the ball rolling again toward homebrewing.

. . .K1CLL■

Gabriel Gargiulo WA1GFJ
160 Elm Street
North Haven CT 06473

Those Funny Looking Cards

"Daddy, what are these funny looking cards I found up in the attic?"

"Cards? . . . Hmm, let me see . . . Why I'll be! WA1ELA, ZL1HW. Well Marc, it looks like you found a stack of my old QSL cards."

"What are QSL cards, Daddy?"

"Well, Marc, before you were born I used to be a ham . . . "

"Ha ha, you were a ham, Daddy, you mean like the ham we had for dinner?"

"No, it's a different kind of ham. You see, there once used to be about 300,000 people in the United States who were very much interested in radio, and liked to fill up a whole room in their house with radios and put up tall antennas in their yards, and talk to other people who had radios in their houses and antennas in their yards."

"Could they see each other over the radio?"

"No."

"Then why didn't they just call each other on the picturephone like we do?"

"Well no, son, the picturephone was different then, you couldn't see the other person. Besides, we liked radio and enjoyed talking with people we couldn't see. It was a wonderful hobby. Why, I remember my first contact as a Novice. What a feeling to hear your own call through the static! But that was nothing compared to the time I worked Japan, England, Denmark and Sweden all on the same day."

"I guess you really had a lot of fun, didn't you, Dad?"

"You bet. I don't know where I had more fun, on the six meter net, or burning up the airwaves while driving along at sixty. I must have put out more signal in one day than the Voice of America did in a week!"

"Why did you stop, Dad, if you had so much fun? Your radio is still up in the attic. Can you show me how it works?"

"Well, I wish I could, Marc, but it's illegal now. You wouldn't want me to go to jail, would you?"

"Gee, no, Daddy! How'd it happen? I mean, it wasn't against the law then, was it?"

"No."

"Then why is it now? What happened to all those hams? Didn't they want to keep being able to talk on the radio?"

"Oh, they wanted to keep talking on the air, all right, but nobody did anything to tell the rest of the people how good ham radio was. They thought that everybody knew hams helped in emergencies . . . "

"You mean like rushing medicine to sick people in south America, and helping people in floods, and calling the Red Cross and things like that?"

"Yes, but how did you know that hams did things like that?"

"I saw some old newspaper clippings you had near these cards."

"That's right. Hams did things like that, and a lot more. They let soldiers talk to their families by radio, and they made people from different countries become friends with each other."

"Daddy, was it the government that made you stop being hams?"

"Yes. Well, not exactly *our* government. You see, all the countries met in Geneva, and they all decided that hams weren't

very useful, and they voted to give away all the ham bands to short wave stations, business radio and a lot of other commercial stations."

"Did our country vote the same way as everybody else?"

"Yes, I'm afraid it did."

"Why didn't all the hams get together and tell everybody all the great things they were doing?"

"Well, they did, son. A lot sent letters to congress, but a few big trucking, oil, and construction companies got together and put ads in all the papers, and had announcements on television saying that they didn't have enough frequencies to carry on their business, and that if they didn't get more frequencies they would have to charge more for shipping, building, and gas. So our government voted against ham radio, like the others."

"Gee, so you had to stop talking on the radio, huh?"

"Yes, but not all at once. One year later they gave 80 meters to the broadcast stations, two years later 40 and 20 were turned over to the short wave stations. What really hurt was when they took my favorite band, 15 meters. The day they closed it up, all I could hear on my favorite frequency, 21.4 mc, was the Voice of China telling the world how peace-loving Red China was.

"Do you think that if hams all over the world had gotten together and put things in the paper and on TV saying all the good things hams were doing, that everybody would have voted to keep ham radio?"

"Yes, I think they would have. A few hams had the idea of hiring public relations men, and of getting a lobby in Washington, but no one did anything about it."

"Gee, that's too bad, Dad. Maybe they could have saved it. I guess it was a lot of fun. Well, good night, Dad."

"Good night, son . . . let me see those cards . . . hmm, I remember that ZL, worked him off the back of the beam too . . . WA1ELA, wife just had their third daughter . . . wonder what 6 sounds like now . . ."

. . .WA1GFJ■

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ADVERTISER INDEX *November, 1971*

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	1	2	3	4	5	6
7	$\boxed{8}$	9	10	11	12	13
14	15	16	17	18	19	20
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EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3A	3A	7	3A	7	7	14	21	14
ARGENTINA	14	7	7	7	7	7	14A	21	21	21	21	14A
AUSTRALIA	14	7A	7B	7B	7B	7B	7B	14	14	14	14	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	21	21
ENGLAND	7	7	7	3A	7	7B	14	21	21	14	7A	7
HAWAII	14	7A	7	7	7B	7	7	7B	14	21	21	21
INDIA	7	7	7B	7B	7B	7B	14	14	7A	7B	7B	7
JAPAN	14	7B	7B	7	7	7	7	7	7B	7B	7B	14
MEXICO	14	7A	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	14	7B	7B	7B	7B	7B	7	7	7	7B	7B	14
PUERTO RICO	7A	7	7	7	7	7	14	21	21	21	14	14
SOUTH AFRICA	7A	7	7	7B	7B	14	21	21A	21A	21A	21	14
U. S. S. R.	7	7	3A	3A	7	7B	14	14	14	7B	7B	7
WEST COAST	14	7A	7	7	7	7	7	14	21	21	21	14A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	3A	3A	7	3A	7	7A	14	21	21
ARGENTINA	14	7A	7	7	7	7	14	21	21	21	21	21
AUSTRALIA	21	14	7A	7B	7B	7B	7B	7B	14	14	14	21
CANAL ZONE	14	7A	7	7	7	7	7A	14A	21	21	21	21
ENGLAND	7	7	7	3A	7	7	7B	14	21	14	7B	7
HAWAII	21	7A	7A	7	7	7	7	7	14	21	21	21
INDIA	7	7	7B	7B	7B	7B	3B	14	14	7B	7B	7B
JAPAN	14	14	7B	7B	7	7	3A	7	7	7B	7B	14
MEXICO	14	7A	7	7	7	7	7	14	21	14	14	14
PHILIPPINES	14	7A	7B	7B	7B	7	7	7	7	7B	7B	14
PUERTO RICO	14	7	7	7	7	7	7A	21	21A	21	21	21
SOUTH AFRICA	7A	7	7	7	7	7	14	21A	21A	21	21	14
U. S. S. R.	7	7	3A	3A	7	7B	7B	14	14	7B	7B	7

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14A	14	7	3A	3A	7	3A	3A	7	14	21	21
ARGENTINA	14	14	7A	7	7	7	7B	14	21	21	21	21
AUSTRALIA	21	21	14	7A	7B	7B	7	7	14	14	14	21
CANAL ZONE	14	14	7	7	7	7	7	14	21	21	21	21
ENGLAND	7B	7	7	3A	7	7B	3B	7B	14	14	7B	7B
HAWAII	21A	21	14	7A	7	7	7	7	14	21	21	21
INDIA	7B	14	7B	3B	3B	7B	3B	3B	7	7	7B	7B
JAPAN	21	14	7A	7B	7	7	7	7	7	7	7B	14A
MEXICO	14	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14A	7A	7B	7B	7	7	7	7	7B	7B	14
PUERTO RICO	14	7A	7	7	7	7	7	14	21A	21	21	21
SOUTH AFRICA	14B	7	7	7	7B	7B	7B	14	21	21	21	14
U. S. S. R.	7B	7	7B	3A	3A	7B	3B	7B	14	7B	7B	7B
EAST COAST	14	7A	7	7	7	7	7	14	21	21	21	14A

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

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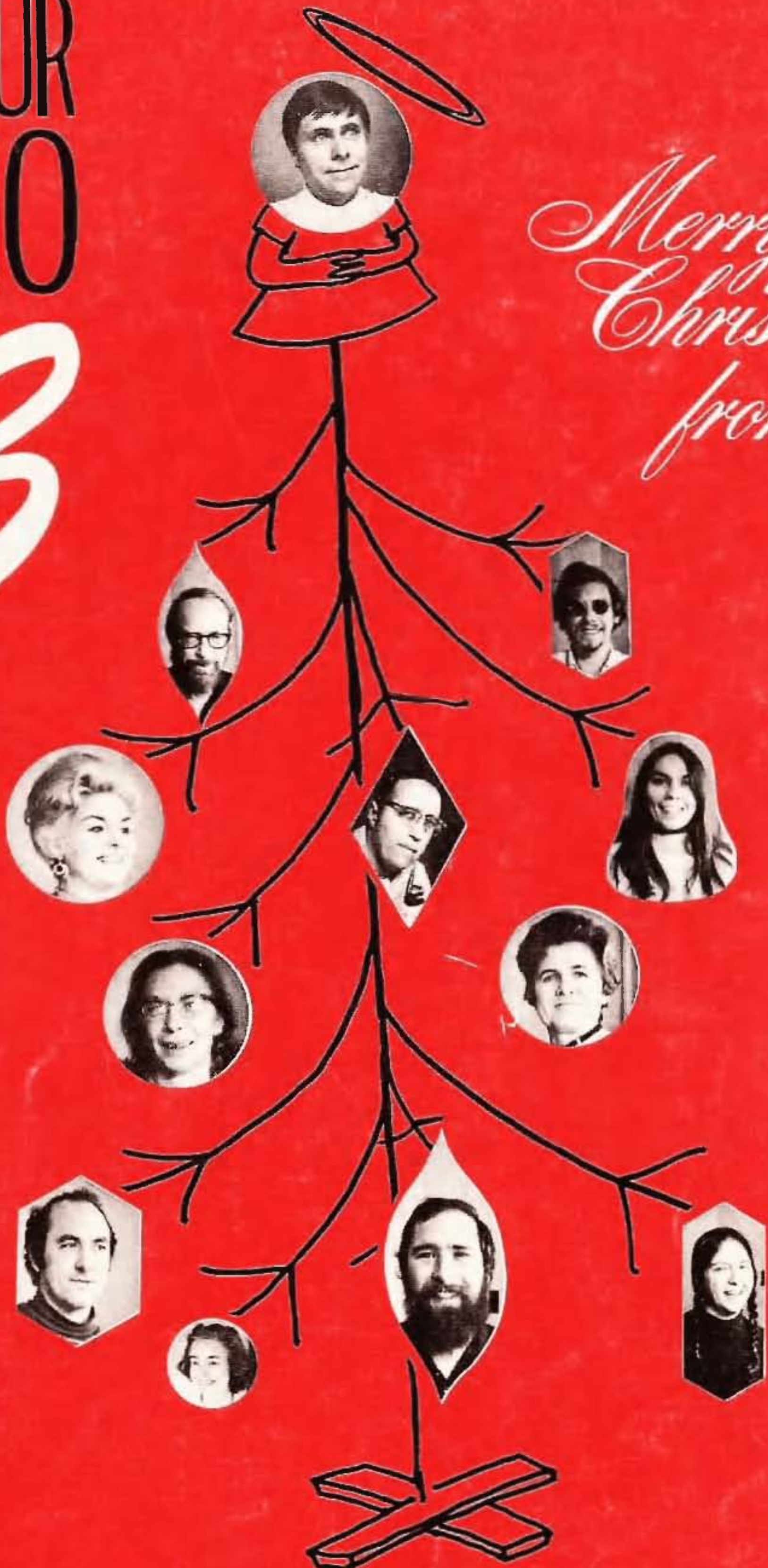

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73 MAGAZINE

#135 DECEMBER 1971

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STAFF

73 Magazine is published monthly by 73 Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas. $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough, N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A.

 Phone: 603-924-3873.

COVER: A fairly merry Christmas from the dedicated little group that brings you 73 each month. Reading down, left to right, we have controversial Wayne Green, editor, resident gourmet cook and bon vivant. Phil Price is next, our architect of the newspages, solver of circulation miseries and about 50 other jobs. Eric Falkof K1NUN, the new assistant editor, will be the scapegoat for all of Wayne's blunders. Aline Coutu, one of the reasons 73 is doing so well with advertising, is a church organist as well as advertising manager at 73. Roger Block, art director, designs covers like this one, draws hilarious cartoons, and smokes a stink-pot pipe. Nancy Estle, our artist, puts together most of the pages of 73 as well as a lot of the ads. Isn't she a doll? Ruthmary Davis fights the vagaries of the IBM composer to set the type for 73 and our growing line of books. Dotty Gibson handles the subscriptions and tries her best to deal with the seemingly insane computer which tries to screw up our mailing list every month. Biff Mahoney tends the cantankerous presses in the 73 printing department. He has developed an impressive vocabulary of blue words which seem to help keep things running. Barbara Block keeps your information requests flowing smoothly (please send in one to her today with a little note of thanks and let her know that she is not forgotten), a chore which helps Aline keep the advertisers happy and, in turn, 73 in business. Taylor Sage does almost everything else. . .like keeping everything running despite the best efforts of our machines to self-destruct, getting the mail, putting on a new roof, binding books and magazines, and etc9. Gigi Sage, Taylor's wife, bookkeeps, making herself known primarily to delinquent advertisers. Taylor and Gigi live in a nice little place they call Motley Gardens out in the woods at the end of a long driveway. If you find yourself in New Hampshire please stop in and say hello to all of us!

Amateur Radio

DECEMBER MCMLXXI Monthly Ham

21 CB'ERS INDICTED

Reprinted from The Cedar Rapids Gazette: October 9, 1971.

DES MOINES (UPI) -- A federal grand jury has returned 121 indictments against 21 Polk County residents on 14 different violations of the Federal Communications Commission regulations.

U.S. Attorney Allen Donielson said it was the first time a grand jury anywhere in the nation had indicted citizen band radio operators for alleged violations of the FCC rules.

The 21 persons indicted, all members of a citizen band radio operator club called "Apollo," were accused of making it impossible for legitmate users of citizen band radios to transmit messages in the Des Moines area.

Donielson said the indictments climaxed a nearly eight month investigation by the FCC, the grand jury and his office. He said some of those named in the warrants were licensed citizens band operators and some were not, and all the alleged violators were "using the citizens band like a ham radio operation."

While a "ham" radio operator can use more power and operate on a wider group of frequencies, Donielson explained, a citizens band radio operator is more limited in frequencies and power.

He said the violations included talking excessive distances, using nicknames instead of designated call letters, and using overheight antennas.

Donielson said the law provides 14 different penalties for the violations, ranging from two years imprisonment or a $10,000 fine, or both, down to a $500 fine.

Through Repeaters...

HAM FM BRINGS AID

by Peter Lascell W4WWQ

On October 3, Amos Rhames K4WQS came upon an automobile accident three miles south of the Virginia–North Carolina state line on US-29. At 11:40 AM, Amos put out a call through the Danville, Va. repeater (WB4QWP, 28/88) for any N.C. stations to make a call to the N.C. State Police. Hearing no reply from Carolina stations, W4WWQ, Lynchburg, Va., replied offering to call the Virginia State Police to see if they had contact with the N.C. authorities. The call was made but they didn't have interstate contact.

A call was then put out by W4WWQ via the Lynchburg repeater (WB4HCX, 34/94) for N.C. stations. A reply came from Bill WB4AXH in Smithfield, N.C. about 150 miles from Lynchburg and 100 miles from the accident scene. Bill contacted his local police department who in turn put the information on the N.C. State Computer Network at 11:50 AM.

While Rhames was at the scene directing traffic on what has been said to be the most heavily traveled two lane road in N.C., he maintained contact with both repeaters.

The state police car arriving at the scene at 12:18 PM had been a few miles south on a radar assignment. It took ham radio FM ten minutes to establish and pass information over the 330 mile round-robin circuit and took the police thirty minutes to move a car about 15 miles.

As it turned out, there were no injuries but there were some hot tempers over the crinkled metal blocking both lanes of traffic. The following stations participated: K4LKQ, K4WQS/M, K4YZR, W4WWQ, WB4AXH, WB4MBO, WB4QXE.

Former Morse Operators Have International Club

When it became apparent that the whole telegram industry would go into automation, a number of active and former telegraph operators in the Western Union, railroads, brokers' offices, private wire systems, news bureaus and others decided to form an organization to perpetuate the achievements of Samuel F. B. Morse and the traditions of the great fraternity of "brass pounders" as they were called. The Morse Telegraph Club was formed in California in 1942 and spread to 60 chapters throughout the U.S. and Canada. Today it has over 4,000 members.

Among those members are many hams, and former commercial wireless operators. Anyone who telegraphed the American Morse code or the Continental code (which hams use) for at least one year was eligible for membership. The big event each year for each chapter is the annual dinner on the last Saturday in April to commemorate the birthday of Samuel F. B. Morse.

On that Saturday each year the Western Union Telegraph Co. of 60 Hudson Street, New York City, has set up a circuit to all the cities requesting contact with the network, so that upwards of 60 cities are on this vast circuit in the U.S. and Canada. The Morse Club appoints a chief operator who tries to maintain priorities on the big circuit, and it functions all that Saturday. Wires are cut into halls, hotel dining rooms, or wherever the chapter is gathered for the annual get-together.

The proceedings and other Morse Club news, including several columns of Morse Club's ham news are published five times a year in a tabloid-size newspaper, *"Dots and Dashes."* Last year the Morse Club opened its membership rolls to hams, too. Dues are small.

Those interested may write O. Hugh Braese, President, Morse Telegraph Club, 1501 West Shields Avenue, Fresno, Calif. 93705

GOLDWATER ELECTED PRESIDENT

Senator Barry Goldwater has been elected president of the Quarter Century Wireless Association for the 1972–1973 term. QCWA, which was founded in 1947, is a non-profit international organization of radio amateurs who have been licensed for 25 or more years. Current membership is over 5200 of which more than 450 have been licensed for 50 or more years.

Senator Goldwater operates station K7UGA in Scottsdale, Arizona and station K3UIG in Washington, D.C.

INTERNATIONAL HAM PHONE PATCH LINKS AILING SON, PARENTS

(Reprinted from the Columbia (MO) Missourian.)

The University ham radio station in Brady Commons reached Central America Saturday night to reassure a University professor whose son was critically ill.

Robert E. Bray, University assistant professor of economics, was contacted Saturday by the American Consulate in Tegucigalpa, Honduras. A spokesman said his son David, 23, was crtically ill with meningitis. David was touring South Central America on foot.

"They (the consulate) told us very little, just enough to be alarming," Bray said. "They said he was very ill with spinal meningitis, and if we didn't send $650 immediately he wouldn't receive proper treatment."

Wanting more information about his son's condition, Bray called a relative who worked in the State Department and a Jesuit priest in Maine who had worked in the State Department in Honduras as a missionary a few years ago. He asked them to try to make contact with his son.

Bray's problem was solved quite unexpectedly. Wally Grossman, a friend of Bray's, called him Saturday morning concerning another matter. When he heard Bray's problem, he suggested Bray go to the ham radio station at the University Brady Commons, and attempt a hookup with Honduras.

Steve Kahle, a graduate student in engineering, took over the radio. Kahle, son of Louis G. Kahle, University professor of political science, had attended University High school with David Bray.

The hookup was complicated and took more than an hour, Bray said. Kahle first reached the Canal Zone, where an operater linked him with Miami. Miami completed the link to Tegucigalpa.

Kahle talked with David Bray and was able to ascertain that he was feeling better. But the Brays wanted more information, and a new link was made, this time through Coral Gables, Fla.

"We found our son quite ill with meningitis, but not as serious as we had believed," Bray said. "He has to be in the hospital for two weeks. We were concerned not only with the possibility of death, but also with the possibility of brain damage. My wife is a nurse and she realized the serious implications more than I. We realized he needed prompt treatment." The Brays sent the needed money through their local bank.

HOLLYWOOD ARC CONTEST

The Hollywood Amateur Radio Club announces its first annual Operation's Day celebrating the first anniversarv of its club call, WB4TON. They expect to have at least two transmitters in operation for the full 30-hour period and offer special QSL's and certificates to participating stations.

Date: January 8 and 9, 1972
Time: 1700Z Sat. to 2300Z Sun.

Frequencies:	CW	SSB
	3570	3930
	7070	7230
	14070	14330
	21070	21430
	28070	28530

Exchange: RST, state, province, or country, and name of operator.
Awards: Special QSL's to stations making contact with WB4TON during the 30-hour period.
Certificates to stations working WB4TON on both CW and SSB.
Certificates to stations working WB4TON on 5 bands. (Any combination of CW and SSB)
Application: Send SASE to W4OZF along with your QSL and a list of all contacts made to WB4TON during Operation's Day to W4OZF, Contest Chairman, 2311 West Nassau Drive, Miramar FL 33023.

HOT GEAR

Starting this month, 73's Hot Gear listing will include a cumulative list, providing a running checklist for hams and dealers to check before buying used equipment. Items will be kept on this list for ten months. Each entry consists of the make and model of the stolen equipment, identification of type of gear if necessary, the serial number and the date of the issue of 73 in which a full listing, with owner's name and call, can be found.

Hallicrafters SR46A	Xcvr	#446100	9/71
Regency 2	Xcvr	#04-03505	11/71
Sonar FM-3601	Xcvr	#1003	11/71
Collins 75A-4	Rcvr	#804	12/71

Stolen from Marvin A. Mahre WØMGI, 2095 Prosperity Ave., St. Paul MN 55109:
Collins 75A-4 Receiver, Serial #804.

DX FOOTNOTES

A 17-year-old ham in Japan is looking for a few ham pen pals around his own age. Kazuhiro Nakao (KH3IWT) lives about 5 miles east of Osaka and his mailing address is 196–9, Shimokosaka, Higashiosaka City, Osaka, Japan. This young man is interested in basketball and he wants to exchange notes of interest with other young adults. Please contact him right away if you are interested.

Attention DXers. ARRL has announced the addition to the Countries List of Annobon Island. Annobon Island is located off the west coast of Africa in the Gulf of Guinea. It qualifies as separate from Equatorial Guinea under point 2A of the DXCC Criteria. Confirmations for contacts with Annobon Island may be submitted starting October 1.

YO2RA

Stefan Rusu YO2RA, seventy-two years old, a ham since 1927, has held calls ER5AR, CV5AR and YR5AR. He worked all continents in 1938 with 3 watts; his present rig consists of a 13 tube receiver, Hertz antenna, and a 60 watt transmitter.

Hilary McDonald W5UNF/6

VIET NAM. Fred Laun W9SZR, HS5ABD, HI8XAL, etc., who is presently a Province Advisor in the Vinh Binh, along with Don Riebhoff K7CBZ, HS3DR, etc., are working hard to get permission for amateur radio operation in this country. They've had a lot of experience with that in other areas, so they just may make it where everyone else has failed. If you have any help to offer write to Fred Laun, JUSPAP/PPA Advisory Team 72, APO 96243 San Francisco.

Kure and Midway QSL cards for the W7UXP/KH6 DXpedition should go to KH6BZZ, no matter what else you may have heard. Bureau cards will not be accepted. Address 45–601 Luluku Road, Kaneohe HI 96744. Donations gratefully accepted.

KAMARAN ISLAND, VS9K, unavailable for about five years now, is expected to be in operation for a few days in early 1972 when Aldo ET3ZU visits there. The Labor Day operation from Jabal al Tair Island in the Red Sea netted over 7000 contacts . . . a very good score indeed.

AVES ISLAND, YVØ should be on in late October if the two radio amateurs accompany the scientific expedition to this remote island as expected.

JORDON. JY9DK was on for a few days form Amman. Darleen will be on from various spots around Europe during November and will be returning to the U.S. in December. SM5AEC is scheduled to be on from Jordan too, so it looks as if there will be no real shortage of JY calls on the bands. King Hussein JY1 still shows up frequently on the bands to reward the diligent DXers.

ZANZIBAR, 5H3LV is trying to get back there again in late December for those who missed Garth's last two visits there in Feburary and April 1970. By now there should be a fair demand built up.

(Thanks to the West Coast DX Bulletin)

DX MAILBAG

Hi Wayne:

As per our contact the other night I am enclosing the shot of Gus Roblot FP8AP.

After some ninety 90 trips to the Newfoundland mainlaind with the ATTA BOY in which he brought ice cream to St. Pierre for sale on the Island, Gus has finally decided to retire his trusty little boat. To let the legend of the ATTA BOY live on, Gus has decided to move it up on the mountain side on St. Pierre on skids, and make a ham shack out of her, for visitor hams to use while on the island, as well as his own shack. Shown here with the ATTA BOY are left to right, George, Gus' son-in-law, Bridget, Gus' granddaughter, and Gus FP8AP.

Bill W1PFA

REPEATER UPDATE

W2NSD/1 report!

On the morning of September 28th I noticed that the two meter band was unusually good. The WA1KGR repeater from Holyoke MA was pushing S-9 on the Standard, where it usually struggles in here about S-4 or so; good copy, but not overpowering. This perked in the back of my mind through the day and, when things went a little blah along about ten that night I headed for the top of Pack Monadnock in the Rover.

Sure enough, signals were excellent. I put the C.T. Power amplifier on the Standard, boosting it to about 80 watts output and made a try to get into WA2SUR 19–73 in New York City. I've tried them before, but never when they were as strong, running an S-2 with a lonnng slooow fade, taking perhaps fifteen minutes to go through a valley and back up again. I made it this time and quickly found myself talking to a bunch of good old friends through that extremely popular repeater. The most exciting contact for me was with Larry WA2INM, who wrote a lot of articles for 73 back in the early days and spent a good deal of time haunting the 73 offices in Brooklyn. Further, he did a good deal of the work of moving us up here, and then visited any number of times while he was going to college in nearby Marlboro VT. Larry was sitting in a bar in Greenwich Village with a TR-22, with his wife Jackie WB2BXY!

INTERNATIONAL AMATEUR RADIOCOMMUNICATION

The FCC has received notice from the Cambodian licensing authorities that pending government approval and eventual International Telecommunications Union notification, there would be no objection to communications between amateur Station XU1AA, Phnompenh, Cambodia, and U.S. licensed amateur stations.

The Commission has no objection to U.S. amateurs communicating with Station XU1AA.

Shifting to WA1KGK in Trumbull CT I added more old friends to the log, plus Jim K3VJH down near Washington, almost 400 miles away, and John K3IBN in Harrisburg PA. I could hear a lot more chaps coming through the Philly repeater on 76, but they were busy with themselves and weren't as excited over working New Hampshire as I was in contacting Philly, so nothing came of it.

The car battery, my perseverence and the band all failed about 2 AM, so I pushed the car to start it and headed home to bed.

Would there by an interest in a repeater contest? I know I would enjoy it, but perhaps I'm in a great minority. Perhaps one which would give one point for every contact made through a repeater, with a multiplier for the number of repeaters used. I'd win, of course, but what better way to set up a contest, right? With a minimum of 22 repeaters available from my nearby mountain, even without a beam, I have quite an advantage. If someone gives me trouble from down in Massachusetts on Mt. Greylock we could throw in a state multiplier to push me back over the top again.

Ken and I discussed an FM contest, but he was violently opposed to it. FMers aren't interested in DX and contests, said he. Maybe not, but a lot of chaps sure tried hard to contact me when the band was open and the rest, with one or two exceptions, cooperated fully. If I get letters of encouragement from a dozen states we can start mulling over the rules for a short fun contest, perhaps 24 hours on a Saturday night through Sunday afternoon. It won't take as many negative letters to turn the whole thing off . . . I discourage easily

DXing The Repeaters

The late September effects of the hurricane sliding up the coast were most pleasant for old timers on two meters. The band went wild, with the FMers finding Ohio repeaters banging into Maine and most of New England, and openings all over the place from the midwest down to Virginia. I drove to the top of my local mountain on three different nights and had a wonderful time working the gang in New York through WA2SUR 19–73. The temperature inversion was so pronounced that I could even see lights reflected way up in the sky from what must have been New Haven, well over 100 miles away.

My old buddy Frank W2OCM was boiling through the New Hampshire repeater W1ALE from Long Island and I worked him on a half dozen different repeaters in short order. My best DX for the evening was K8WKE in Utica Michigan who was hearing me through W1ABI in Vermont and coming through on 88 direct! My 34 receive channel was awash with signals from New York and New Jersey and I had better luck listening 34 and letting them hear me through one or more of the 34–94 or 34–76 repeaters.

Ernie W1FPT down in Bridgeport CT probably did the best of all with his 100 watts and beam. He worked all over the place. I wonder if we shouldn't think in terms of making a certificate available for working through 100 repeaters? Perhaps a tape cassette of the CW identifications coming back would be proof? I know I get a kick out of lifting a repeater out in Ohio or western Pennsylvania and hearing the identification come back.

CA WA6SIN Ventura Cty. 28–88
CO Broomfield 01–61 proposed
CO WAØVUO Denver 04–64
CO Denver RTTY 10–70
CO WAØVIV Colo.Springs 16–76
CO WØIA Boulder 16–76
CO WAØBAG Saginaw Peak 16–76 proposed
CO WAØZCI Monte Vista 16–76 proposed
CO Pueblo prop. 19–79
CO WBØERV Buckhorn Mt. 25–85 No. CO
CO WAØSNO Pueblo linked 28–88 to WØENA
CO Denver simplex 88–88
CO Denver prop. 31–91
CO WØWYX Denver Squaw 34–94 Mt.
CO WAØSNO Pueblo 34–94
CO Denver prop. 37–97
CO KØOVQ Denver CD 146.82–147.30
CO Arapahoe Cty. CD 147.06
CO Prop. CO 58–88 simplex
CO State RACES
CO WAØVVC Denver 145.20 444.35–449.35
CO WAØFTM Broomfield 444.40–449.40
CO WØWYX Squaw Mt. 444.45–440.45
CO WØIA Boulder 444.55–449.55
CO WBØERV Buckhorn Mt. proposed 444.85–449.85
CO WØENA Pueblo 53.0–52.525
CO Statewide simplex 52.525
CT K1IGF New London 19–94
FL WB4KNQ Merritt Island 34–76 443.1–448.1
GA WB4KLM Augusta 34–94
HI KH6EQF Honolulu 449.15–444.15
HI KH6FOX Waikiki 16–76
HI KH6EQK Mt. Holeakala 444.15–449.15
IA WAØVVA Linn Co. 34–94
IA KØJIU Council Bluffs 22–82
IL WA9DZO Chicago 10–85
IL WA9DZT Chicago 52.76–52.64
IL Chicago 46–88
IL Chicago 147.40–147.81
IL WA9ORC Chicago 448.75–443.75
IL WA9TEC Decauter 34–94
IL WA9SGJ Graymont 16–94
IL WA9EAT Joliet 28–987
IL K9CLW Winnebago 82–147.30
IL WA9LIV Waukeegan - 34–76 (1950 Hz Wimot WI access)
IL WA9ORC Chicago 34–76
IL WB9AEF Peoria 34–76
IL W9DGV Rock Island 34–94
IL W9DGV Rock Island 34–76
IL K9CLW Winnebago 82–147.30
IL WA9LIV Waukeegan 34–76 (1950 Hz Wimot WI access)
IL WA9ORC Chicago 34–76 (1800 Hz no., 2000 Hz so.)
IN W9ZPP Evansville 52.92–52.525
IN K9JSI LaPorte 22/34–76
KS WAØVVW Pittsburg 34–94
LA WB5CDP Monroe 52.827–52.525
LA W5MLE Morgan City 34–94 (+440.0–146.94 & 444.5–52.525)
MA K1FFK Mt.Greylock 52.78–.525
MA WA1KFZ No. Adams 10–70
MI WB8CSA Benton Harbor 34–94
MI W8MAI Benton Harbor 94–76
MI K8WKE Utica 28–91
NH WA1KGO Peterborough 19–79 (was 37–73)
NJ Oakland 16–91
NY WB2BLU Yonkers 31–91
OK Okla City 16–76
RI W1HQV Providence 16–76
SD WAØVVG Sioux Falls 34–94
SD WØBXO Brookings 34–94
TN W4BS Memphis 22–76 444.0–449 0
TX WA5SNJ Pasadena 34–94
VA WB4QDP Arlington(DC) 31–91
WI W9ROM Milwaukee 34–76 (2250 Hz Slinger; 1700 Hz Grafton)
WI WA9PBW Madison 34–76 (2100 Hz)
WI WA9WVE Madison 46–88
WI W9AIQ Sturgeon Bay 34–76

CANADA

BC VE7ELK Chilliwack 46–00
BC VE7CAP Kimberley–Cranbrook 34–94
BC VE7BTU Nelson 46 147.33
BC VE7AFG Prince George 58–147.33
BC VE7CAQ Trail 34–94
BC VE7RPT Vancouver 34–94
BC VE7BEL Victoria 22–147.54
ONT VE3SAR Sarina 34–94

Thanks to WB4EAB, WA9TKA, WB6MAY/VE7, WAØ RLQ, K6YLQ.

SOCIAL EVENTS

BOSTON HAM AUCTION

Boston College ARC (W1PR) and Middlesex ARC (W1HEB) are jointly sponsoring an auction of radio and ham gear to be held Friday, November 26 at Campion Hall, Boston College, Beacon Street, Newton MA, at 7:00 PM. All area hams are urged to attend, bringing any gear they'd like to sell. There will be a raffle and refreshments will be available.

SEPTEMBER VHF CONTEST

The results of the Honeywell Radio Club (W1DC) effort in the September VHF contest are interesting to mull over. They operated on seven VHF/UHF bands, 50 through 5650 MHz, and made 881 contacts in 29 different sections. The most contacts were made, naturally, on 50 MHz, where they made 432 in 28 sections. Interestingly, 18 of those were on FM, 90 on AM and 324 on sideband and CW! On 144 MHz they made 106 FM contacts, 152 AM, and 107 sideband or CW contacts, for a total of 365 in 21 sections. The best distance on 2m was West Virginia, Virginia and Ohio. Ten contacts were made with Maryland–DC! On 220 MHz no AM was used so there were 17 FM and 18 SSB/CW contacts for 35 total in 13 sections. The 432 MHz results might have been better with some FM, but 31 contacts were made on SSB/CW and 6 on AM, thirteen sections contacted. There were seven contacts on 1296 with 5 sections, the furthest being New Jersey. Four neighboring sections were contacted on 2400 MHz and one on 5650 MHz. Would there be any interest in 73 providing a special certificate of merit for two-way contacts between any two stations on six VHF bands? That sounds like an interesting goal.

DELAWARE QSO PARTY

This contest runs from 2300 GMT Dec. 18 to 2300 GMT Dec. 19. The exchange will be QSO number, report and county (for Delaware stations) or state, province or country for non-Del. stations. Suggested frequencies: CW, 3560, 7060, 14060, 21060, 28060; phone, 3975, 7275, 14325, 21425, 28650; VHF 50.4 and 144 MHz. Novices on 3710 and 7170.

Awards: A certificate will be awarded the highest-scoring station in each state, Canadian Province and foreign country (with 3 or more contacts) and to the highest-scoring station in each Delaware county. In addition, a W-DEL certificate will be sent to any station working all three Delaware counties. Logs showing required date will be accepted in lieu of QSLs. The mailing deadline is Jan. 1, 1972. Send your log to Mark Augustin WA3OYA, 2119 Barr Road, Wilmington, Del. 19808. Persons wishing the W-DEL certificate must apply to this address. No fee asked, but SASE is required.

CINCINNATI STAG

"Without mud it wouldn't be a Cincinnati Hamfest," as one astute observer so aptly phrased it. Nevertheless, quite a number of brave lads from the far corners of Ohio and the nation braved the forbidding muck to set up table and tent in pursuit of an unfrozen buck.

This year's Cincinnati Stag Hamfest boasted an added treat in the person of Bob Mathews, K8TQK, the notorious "voice" of "Miamisburg's Finest Repeater," WA8PLZ. Our enterprising cameraman caught Bob in festive cowboy hat and jovial mood at left in the picture above. This is the last known photograph of Bob, who was last seen sinking rapidly in a plate of roast beef.

At right in the photograph is Miss Floozie O'Toole, an agent of the Women's Liberation Movement, who successfully infiltrated the traditionally all male event by disguising herself as a set of Drake equipment.

...WB8LBV

WITH THE FCC

WA3NIL fined $100 for operating on unauthorized frequencies.

WA3OFK proposed revocation of license for not answering FCC mail.

WN4RGR revoked for failure to answer FCC mail and violations.

WA6GMR revoked for failure to answer FCC mail and violations.

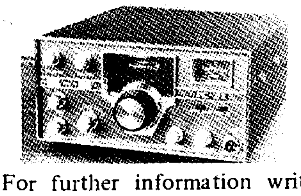
WB4KGL proposed revocation of license.

This may seem like a lot, but it is miniscule amid the hundreds of CB fines and revocations.

NEW PRODUCTS

TWO NEW FM TRANSCEIVERS ANNOUNCED

The Icom IC-20 and IC-21, which have been coming back from Japan under the arms of returning servicemen, are now being imported by our old friends at Adirondack Radio in Amsterdam, New York. Both are 10 watt FM two meter transceivers, with the IC-20 having 12 channels and the IC-21 24 channels! In addition there is an accessory vfo for the IC-21 to permit continuous tuning of the receiver. The IC-21 has an S-meter, an SWR meter and even a discriminator meter built in. There is a protection circuit which turns off the final if the output is shorted, open or likely to damage the transistors. The IC-21 operates from either 13.6 volts or 115 V ac. Both use 18 MHz crystals for the transmitters and 15 MHz crystals for the receivers



For further information write to *Adirondack Radio, Box 88, Amsterdam NY 12010* or watch 73 for a review of the IC-21 at an early date.

Automatic Alarm

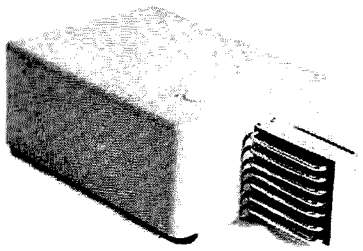
Whether you have a rig in your car or not you need an alarm these days The estimated life expectancy for a Corvette parked on the streets of New York is now about 17 minutes, average.

The Technical Product Development Company, Box 84, Nutley NJ 07110 has come out with an alarm system for cars which does just about all you could want. For $50 it will set itself automatically and sound your horn, flash lights set off a siren, etc as well as prevent the car from being started if anyone opens a door, hood, trunk, or messes with the ignition. You have seven seconds after opening your car door to turn off the hidden switch to prevent all hell from breaking loose. They have other models for $20, $30 and $40 with progressively fewer features They claim that the gadget is easily and quickly installed.

The Immovable Key

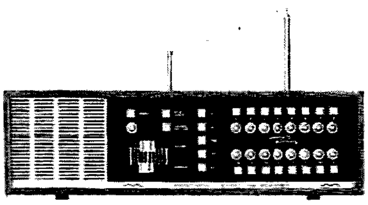
How about a key with no paddle movement at all! With no keying contacts, and completely solid state, the Data Engineering key operates by touch alone. The key has two insulated electronic grids which, when touched, operate the ICs. With this system there can be no problems with contact adjustment or bounce since there are no contacts.

The key operates from two C cells and uses two ICs and two transistors. It is carefully shielded against rf. Weighting prevents the key from walking.



How Data Engineering can turn out this remarkable key, with a 5-year guarantee, for only $19.95 is surprising. You can get a spec sheet from them if you write to *Box 1245, Springfield VA 22151.*

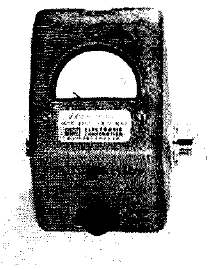
16 Channel Scanning Receiver



Regency Electronics, 7900 Pendleton Pike, Indianapolis IN 46226 now has a 16-channel scanning receiver available. This covers the 50, 146 and 450 MHz bands, enabling you to monitor repeater channels on all three bands. Push buttons activate the channels you wish to monitor. Manual switching of channels is also possible, naturally. The built-in antennas can be bypassed with outdoor antennas and the built-in speaker can be bypassed if an external one is preferred. Price? $219. This would seem to be an excellent FM scanner for the serious FMers as well as the FM amateur with irons in other fires such as the need to monitor police, Apollo 16, the mafia, or whatever.

New BIRD Ham Wattmeter

Confirming rumors current during the past year, Bird Electronic Corporation has announced the debut of an RF Wattmeter designed especially for the ham market. There are actually three models, two of which cover the 1.8–30 MHz range (160 meter to 10 meter bands) and the third covering 50–150 MHz (6 meter and 2 meter band). The Model 4350 measures forward and reflected power in two ranges: 200W and 2000W, while the Model 4351 has ranges of 200W and 1000W. The Model 4352 has ranges of 40W and 400W covering the two VHF bands of six meters and two meters.



The new line of wattmeters are designated HAM-MATE™, and use the well known Thruline® construction, made famous in the industrial field by the Model 43. The new 4350 Series Wattmeters emphasize dependable rf power measurement, in the tradition of Bird rf wattmeters. Special attention is given to the directivity of the Ham-Matè, which is the ability to differentiate between rf power flowing in opposite directions in a transmission line. The new Ham-Mate has a minimum of 20 dB directivity which assures meaningful reflected power (and vswr measurement).

It is anticipated that the Models 4350 and 4351 will be available for delivery beginning in October 1971, and the Model 4352 in December 1971. All three models are priced at $79 user's net price.

Write *Bird Electronic Corporation, 30303 Aurora Road, Cleveland OH 44139* for further particulars.

NEW NATIONAL TRANSISTOR CATALOG

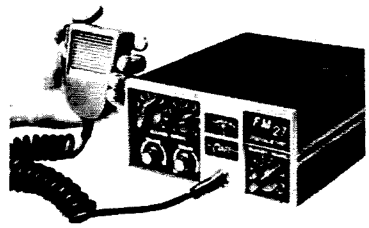
A new 130-page Transistor Catalog is now available from National Semiconductor Corp. The catalog provides complete data on National's entire transistor line including NPN and PNP small signal transistors, Field Effect Transistors, and Pro-electron types. In addition to specifications, the catalog provides Process No. design/application data and test limit information. A glossary of terms and package outlines are also provided. For a free copy, write to *National Semiconductor Corp., 2900 Semiconductor Drive, Santa Clara CA 95051, Attn: Marketing Services.*

FM TRANSCEIVER RECEIVES ANY 2-METER BAND CHANNEL . . . WITH CRYSTAL CONTROLLED PRECISION

Clegg Division of International Signal & Control Corp. has announced the immediate availabilty of its new completely solid state FM-27 mobile transceiver.

The principal feature of the transceiver is the CRYSTIPLEXER tuner, a new synthesizing system that allows any channel in the 2-meter band (146–147 MHz) to be monitored with crystal precision – but without the need for additional crystals. To monitor any specific frequency within this band, the operator merely sets the two receiver controls to numbers corresponding to the desired frequency. To monitor 146.94, for example, the operator sets the first control to 9, and the second to 4.

Receiver selectivity is rated at 70 dB of adjacent-channel attenuation. Sensitivity is rated at better than 0.35 μV for 20 dB of quieting.



The transmitter portion of the FM-27 is a 10-channel solid state device with a power output of about 20 to 25W of rf.

Weighing less than three pounds, and measuring only 3½" H. x 7-7/8" W. x 9¾" D., the transceiver is packaged in a rugged anti-theft case with a special locking-clamp mounting. Two crystal controlled transmit channels and a PTT microphone are included in the suggested amateur net price of $449.95.

Further information on the FM-27 mobile transceiver is available from *Clegg Division, International Signal & Control Corp., Box 388, R.D.#3, Lititz PA 17543.*

New Hep Catalog

Motorola has just announced their new cross reference guide to their entire line of semiconductors, publication HEP HMA-07 and it includes the type number, basing diagram index, packaging index, specs, maximum and minimum ratings, electrical characteristics, etc. This includes 168 new hobby devices just introduced. Replacements are listed for over 30,000 different semiconductor device numbers including 1N—, 2N—, 3N—, JEDEC numbers, Japanese, Dutch and other foreign numbers. See your Motorola HEP distributor for a free copy of this new catalog.

EDITORIAL BY WAYNE GREEN

Meaningful Contacts

One of the more consistent complaints lodged against our hobby is that so little of our incredible communications capability is used for the exchange of more than superficial information.

Unfortunately the complaint is an all too legitimate one. Considering the reasons why this is so, I wonder if anything can really be done to reverse this pattern? Perhaps a look at some of the more basic reasons will help bring the problems into focus and give us some insight into solutions. Maybe not.

While the resultant lack of any real communication is the common result, there are several causes for this and each has to be considered separately. The chap on the two meter FM repeater has his trade-offs which limit the use he can make of that facility. The DX operator has his problems, some the same, others quite different. The Novice has his miseries, and so it goes.

Perhaps if we start with the more narrowly limiting factors and close in on the generally inhibiting situations we can best outline the whole problem. For instance, the operator working through an FM repeater has a whole bunch of cards stacked against him when it comes to opening up an interesting and meaningful conversation with someone else.

First of all, one or the other is probably driving a car. This means that a good portion of his attention is on the car driving and his radio contact has to take second place in his mind. If there is a second person in the car, this further divides his attention, and you will notice that little of what you say to this chap seems to have gotten across at all. You will be right.

Operating through a repeater could possibly work out well if two ops were putting good signals into the repeater, both had nothing whatever to do except pay attention to the other, both knew that there would be no interruptions, and both had lots of time and knew that they both had the time.

But it doesn't work this way at all. Few repeater users do not have the psychological feeling that they should get off the pot as soon as possible to make way for someone else. One, the other, or both are preoccupied with something else. The signals often fade in and out, losing part of the conversation. One is wideband – the other narrow – and one therefore finds it difficult to understand the other, even when the signal is strong. And so it goes.

Add to this the fundamental difficulty of communicating with a person you don't know, whom you can't see, about whom you know little, if anything, a person you can't even hear except when you stand by for him, cutting off those conversation reinforcing grunts and uh-huhs which help keep two people talking with each other. The restriction of having to talk with no reinforcement, covering everything the other chap has said (as nearly as you can remember) and then originating new things to talk about is a very severe one. It is no wonder that such a large percentage of the radio amateurs stick pretty much to short recitations of their equipment and the weather.

The amateur radio type of contact is quite abnormal and has no counterpart in our learning process, so most of us are unprepared to tackle the difficulties it poses. Even on the telephone you can hear the reinforcing noises of agreement and be stopped when the other person has something to add or disagree about. Way back in the long-dead past of amateur radio this type of communication did develop for a while. Oldtimers will remember with great warmth the duplex contacts on 160 meters where it was possible to just leave your rig turned on and tune in to your contact on the other end of the band. Just like the telephone.

When sideband started and VOX became the way to go, this system looked as if it would partially bring back the old arrangement. But the clank of the relays was too much for most operators and, after uh-huhing between sentences to keep that conflabbed VOX from tripping, they went back en masse to push-to-talk.

While a few of the DX brethren do indulge in interesting contacts, most of the exchanges are of little more value to anyone than the hasty hello over the local two meter repeater. The pressures of other stations trying to work your rare one, fading, other contacts on frequency, and such jazz make long contacts rare. Even if you have the ability and experience to manage an interesting contact you would be hard put to bring it off.

I would dearly love to talk with YA1GNT for an hour, yet I have one devil of a time carrying on an hour contact with Chicago a good deal of the time. Oh, I can make it now and then, but I have to lose a lot of sleep waiting for the right conditions.

Are there any answers to the problem? Are there any changes that might be made so more or us could indulge in meaningful conversations via our incredible amateur radio bands? I think so.

There are no simple answers to such a complex set of problems, obviously. But we can all help out if we are first of all aware of what we are missing and make a determined effort to move in the direction of better use of our bands.

On the FM repeaters I would suggest that repeater owners seriously consider the installation of a second or third repeater. While the spectrum between 146–147 MHz is about full in many areas, there is still little going on in the 145–146 and the 147–148 bands. The emerging 220 units will make that band an invaluable addition to the two meter repeater setup. With enough repeaters we can afford the luxury of long-winded contacts. With both 146 and 220 repeaters we might even develop a duplex system of operating. The use of two- or three-minute timers on repeaters will aid the mobile operator in getting a word in when two long-winded ops are talking. Timers like that will also shorten some of the endless and pointless pontifications which drive ops off the air for weeks at a time when they get snagged.

I'd be very interested in what you, the reader, thinks might improve our ability to use amateur radio for true communication. Should phone patches be eliminated except for serious emergencies? Should nets be curtailed or encouraged? Should DX for QSL card purposes be channeled to a small set of frequencies? What *can* we do? Here we are, able to talk anywhere in the world, and what do we do?

When you consider that we have virtually the ONLY system for people-to-people contact around the world, perhaps you can appreciate the importance of our really making something of it. Tourists rarely get to meet the people in a country they are visiting. They meet the tour guides, hotel clerks, and taxi drivers, and that is about it. No wonder so many Europeans have incredibly distorted ideas of Americans . . . they know us from our movies and television ex-

ports, and an occasional camera-clad tourist who bumped into them on the street. How much do you know of Yugoslav people . . . their lives, interests, foods? Yet I doubt if any serious DXers have talked with less than a hundred YU stations.

What can we do? I think all of us are open for suggestions and ideas.

SAROC

A reader wrote to ask what it is about Saroc that we make such a fuss over it. Mostly I guess it is because this is one of the best run and most carefully planned hamfests in the country. I know I have a wonderful time there because I can get together with the amateurs who are making the news and the manufacturers with the newest products.

Like you, I'm interested in seeing and feeling the latest ham gear, whether it be FM, SSTV, or sideband. I enjoy talking with the men who design and make this equipment . . . to find out what they have in mind for the future . . . what problems they've had . . . how things are selling. I like to pass along reader questions about difficulties with the equipment and my own personal miseries that I may have had.

The 34–94 repeater allows me to talk the clock around with interesting FMers and meet the fellows who are designing the most sophisticated repeater installations.

The technical talks are usually fascinating and give me a lot to think (and write) about. The parties are even more fun, whether it be mass elbow bumps put on by manufacturers or bashes in the private rooms in the evenings.

The $12 per double room at the hotel makes the visit relatively inexpensive as long as I stay clear of the gambling tables and devices. The expensive shops are a delight to look into if I am there alone, and a caution if my wife is along.

It's fun . . . and that is what amateur radio is all about, right?

Articles wanted...

Come on you fellows who are working with ICs, break loose with more articles for the rest of us. We know you can make up a frequency synthesizer now that will let the Novice use crystal control and still hit every kHz or even 0.1 kHz across the Novice band. We know you have worked out many ways to replace the dozens of crystals needed to hit all those FM repeaters with a synthesizer for the receiver and transmitter. We know you have some fabulous new RTTY converters and AFSK generators. We know you can build 24-hour clocks for the shack that count the Hertz arriving from Con-Ed and wink at us with numbers. We know you can varactor yourself up through any of the UHF bands with substantial power. What we don't know is if you can write about these modern wonders.

You say you have a mini-repeater in your car so you can work through the local repeaters even with a hand unit? Details . . . give us details. You are proud of your remote base up on that mountain, complete with sophisticated controls . . . write about it so more of us can join the fun. You have a Touchtone system that is unusual? Let's go!

Status Quo of CB

The 1970 FCC annual report disclosed that a total of 886,951 stations were licensed to operate in the Citizens Band. During the year 26,327 new stations were added while but 951 were dropped. Perhaps that will put to rest some of the exaggerated reports circulating citing over a million CBers. That growth figure sure would look good in the amateur service, wouldn't it!

Scaling as a Way of Life

Several months ago we built up one of Heath's counters and it has seldom been turned off since its first test run. Normally it sat on top of the sideband rig, reading out the frequency a la the Signal One . . . "Hmmm, let's see there, Gus, I think I'm on about fourteen point two one eight three seven seven, how's that check with your receiver dial?" Heh, heh!

All this was a barrel of laughs, but it didn't help much with the mysteries of what is tuned where on two meters since this was a good bit above the range of the IB-101. And two, as you may have read, is where it's at these days. Particularly around here at the 73 pad, it's at.

Chancing to read one of the fascinating ads in 73 (I find the ads in 73 much more interesting than those in other magazines, don't you?), I noticed that Vanguard Labs was making a nifty little contraption designed to solve my problems. A Scaler. This gadget divides things by ten, which is just the ticket for counting down from 146 MHz.

Down in my cellar workshop I have one of the world's nicest old frequency meters, the Navy LR-1. This kluge weighs in a 98 pounds of hernia-inducing bulk and has about fifty tubes. It was built by General Radio, so you know it was the state of the art back when. The LR-1 has done well for me down through the years, I have to admit. With it I could read out most frequencies to a cycle or two if I made a project out of it. That's almost as good as the IB-101, which feels like it weighs about six ounces.

At any rate, today I have the IB-101 and the Vanguard Scaler on the desk and with them I can get the FM transceivers right exactly on channel instantly. I poke the prod over near the receiver oscillator and read out the 136 MHz frequency there (146.94 – 10.7 (i-f) – 136.24 MHz). A quick tweak and it's on channel. Then I probe near the coax output and tune up the transmitter. With the counter on the Hz position it counts in tens of cycles, which is closer than your quivering hand can probably adjust the trimmers. While it varies from rig to rig, I've found that several of them drop about 500 Hz when I put them back in the case. Now I know and you know that one half a kHz isn't going to make the slightest difference to anyone, but perfection is perfection and we have the means, so why not be perfect? Right, so we tune everything up a bit high and it all drops into place back in the box. For a while.

Quite a few FM rigs come and go here, so the counter is in use almost every day. And of course, every time I am going to take a trip anywhere I have to get out my tray of crystals (I'll sure be glad when frequency synthesis is the order of the day) and re-crystal for the new area. In go the crystals and tweak, tweak, they are on channel, and I'm off to New York City or Chicago, ready to join the fun wherever I am.

Just going up on the local mountain, Pack Monadnock (where we keep the WA1KGO repeater), calls for a good deal of encrystalization. If you are on the go you could do worse than drive to the top of this lump, the highest place you can drive in Southern New Hampshire. From there you can work through so many repeaters it will make your head spin . . . W1ALE, WA1KGR, W1KOO, WA1NJR, K1MNS, WA1KGO, WA1KGP, W1ABI, WA1KFZ, WA1KGM, WA1IMO, W1QFD, WA1KRJ, WA1KFX, K1ZAW, K1ABR, WA1NEU, W1MTV, W1PRI, K2AE, WA2UYJ, and perhaps a few more if you wait for the squelch tails to stop and if too many fellows aren't on channel using closer repeaters.

Impressing Relatives

Or friends, for that matter. What amateur hasn't had to try and explain the hobby to some long-lost visiting aunt or cousin? It is difficult. They look puzzled and not very interested. Our hobby is a damned impressive one to us and we want them to appreciate what miracles we accomplish. The usual scene following the attempts to explain is one of demonstration . . . and it is frequently a disaster, leaving the aunt convinced her nephew is an idiot.

(Continued on page 10)

W2NSD/1 *(Cont. from page 9)*

The chap with a DX-20 on CW has no chance and he knows it, so (unless he really *is* an idiot) he flips through a few choice QSL cards to prove his prowess and lets it go at that. The seasoned DXer may put his reputation on the line by turning on twenty meters and tuning for something better than average. I've tackled this with success at times, netting an interesting contact with an ornithologist in Finland on one important occasion.

The other day I was worried and I admit it. It was during my folks' wedding anniversary celebration up in northern New Hampshire and all I had with me was a little two meter Handie-talkie. There I was, sitting in the back seat of someone else's car trying to explain amateur radio to an aunt I hadn't seen in twenty years. I talked about working DX and then got into describing repeaters. She heard what I was saying, but it obviously wasn't making much sense.

I pulled the little HT-220 out of my jacket pocket and turned it on . . . silence. Hmmm, not so good. We were driving through the White Mountains about 50 miles from W1KOO in northern Vermont . . . could I make it? I flicked the button and the squelch-tail came back on cue. I announced myself on channel and hoped. Back came a VE2 mobile in Montreal! We talked for about five minutes and the effect was most positive. She *was* impressed. So was I, to be truthful. I wasn't at all sure I would be able to get through from the back seat of a car with a little two watt Handie-talkie over that difficult path. Needless to say I rested on my inflated laurels and didn't go on to prove that the contact was a fluke that might be difficult to repeat.

Thin 73 This Month?

We appear to have been taken to the cleaners by three of our trusted Massachusetts advertisers to the tune of an amount about equal to two complete issues of 73. This is not only frustrating since they ignored our suggestions for improving their advertising, but we bent over backwards to help them and got nothing for our efforts. We will have to cut back a little on the thickness of 73 for a month or two to make up for this royal rip-off.

. . .Wayne

LETTERS

ou goons don't ever proofr

I insist that you print ev

The VU9KV DXpedition was organized by me in April (12th to 21st) and I was at Port Blair in Andaman Islands for 225 hours. During this time I must have been QRV for approximately 170 hours allowing for sleep(?) times, mealtimes and the times when the power was off or voltage too low (160) for the relay to operate (Surprisingly the FTDX works at even such low voltages as long as it is upside down and I have a pencil to push the relay!). During that period I made 4661 contacts mostly on 10, 15 and 20 meters. Had just a few contacts on 40 and 80 meters. Conditions were extremely poor, but I was glad that I was able to perform better than the other expedition that was being operated at the same time. Fortunately the band conditions were not too good during some part of the daytime and we were able to see some of the picturesque countryside and take some pictures. The XYL was also there for moral support and enjoyed the holiday. The QSL business was very ably handled by Clyde W6KNH.

Venkat VU9KV
New Delhi

I just received my copy of October 73 and was surprised that you published the article on page 79 by WA1FBH entitled "Back to mother earth the easy way." I have seen this type of article many times in the past, and if you only wanted to get the pipe into the ground this is okay, but if a good earth ground is what you want, then this is about the poorest one you could get.

No doubt the article was written in good faith, but you will find if the pipe is say ½ inch in diameter that you will end up with a hole in the ground about 1 inch or more in diameter and the pipe swinging in this only making contact a few inches at the bottom.

I have been an electrical worker all my adult life and in our work a good earth ground is often important. If you wish to test your ground take the YXL's electric iron and your ac meter (accuracy here doesn't matter so much) plug the meter into a duplex outlet and read the voltage, then plug the electric iron in the other of the outlets on the duplex outlet, read the voltage and make a note of the drop in voltage.

Now take a couple of pieces of wire (number 14 or larger) long enough for one to go to your ground rod, the other long enough to reach an ac outlet. Put a duplex outlet on these two wires, fasten the one wire securely to the ground rod, then plug the other wire into the "HOT" side of the duplex outlet furnishing the current. Now use the duplex outlet you put on the two wires and make the same test as above using the ac meter and the electric iron.

If you get as many as two times as many volts drop in this last test as the first, you have a very poor ground.

Harold D. Mohr K8ZHZ
Gahanna OH

Have been waiting some time to read in the letters column something about the cover on the July issue of 73. Noticed a letter from a Texas ham offering to send you a Texas plate. I felt sure, by now, that someone would question the W6 plate from the state of Tenn. which I believe is the fourth call area, also holding fourth in a prominent position on the front cover of July 73. Anyway: Love your mag: read each copy over several times, even read the ads. Someday, please, how about some articles ABOUT FAST SCAN TV?

Harry E. Neff W9UBF
Anderson IN

Out of call area plates are particularly treasured. Though I am not a license plate collector, other than call plates, I do want to thank everyone who has kindly sent me plates. We will be metalling the barn wall with them . . . and hope someday to have enough for another picture. ATV? Come on fellows, let's see some articles on using the new ICs for TV.

Your magazine has gone VHF and I am not interested in the high meter bands. I do, however, like the books on the lower bands as those are the ones I work. The VHF equipment costs, the lack of range, the lack of CW, the FM, etc., just do not appeal to me.

Thomas Piepenbrink WA9SRB
Fort Wayne IN

Tom, what does it take to please you? In looking over the last few issues, in August there was not one single VHF article. In September there was ONE VHF article. In October there were only THREE! Now that comes to a total of four out of 47 articles, or less than 10%. Is it possible *to please you? Being honest, it must be admitted that we have been underplaying FM and VHF a little for the last few months to bring the magazine back into balance and that the per-*

centage of VHF will most certainly be higher in the coming months than it has been recently. Tom, you could do a lot worse than visit your local distributor and just listen in to the activity on the Fort Wayne repeater. Hundreds of amateurs are having the time of their lives with this, so don't sell it short . . . particularly without even looking into it. It does NOT have to be expensive at all. I like the low bands and would never give up my low band fun . . . but I am having a fantastic time on FM and I feel deep regret when I am unable to even get someone to try *something that I find so much fun.*

In the last few issues of 73, and in numerous issues of other ham publications, there has always been reference to the CB problem. We all know there IS a problem, and it is, in my opinion, definitely a threat to the existence of amateur radio, at least as we know it today.

I work for an electronics retail outlet, handling CB radio, along with stereo equipment, here in Dover, Delaware, and therefore am in daily contact with the CB world. For this reason I feel somewhat qualified to discuss them.

Needless to say, I am 100% against relinquishing any amateur band for use as a CB band. It happened once before, and anyone who cares to take the time to look, can see it was one tremendous mistake on the part of the FCC. It did not result in more hams, more legal CBers, or any other benefits to anyone but the electronics manufacturers. How can anyone, especially anyone who ever listens on the CB band, suggest that to give the CBers a legal "hobby license" is going to improve their operations, or is going to result in anything but double jeopardy?

I notice in literature from Antenna Specialists, they push the EIA proposal to allocate 146–148 MHz to CB hobby operations. While this newsletter is not up-to-date on the 220 Mgz proposals, it certianly shows where the amateur stands in relation to large antenna manufacturers. Shall we create even more of a market for CB equipment, further forcing the prices and availability of amateur gear out of our reach?

Here in this area the tremendous amount of illegal operation amazes me. I know of several companies using CB radio legitimately, say, five or six. The balance of the local CBers seem to have no idea of the content of the regulations, let alone have the desire to follow them. Thisincludes the local REACT operation, with which I am familiar. I know personally several "good citizens" of the REACT, running linears, 40 foot towers, etc., in REACT operations. They say they have to have the linears in order to get through in times of emergency. Possibly true, but comparable to my stating I have to drive 60 miles an hour in order to get through the local residential areas in self-defense, because a few others are. Bull. I sincerely doubt I could find 20 people in the Dover area who use CB radio as intended. How many are in the area? I don't know, but from my store window I can see 5 CB ground planes in one housing area of about 30 houses.

A week ago, a customer asked me for an rf wattmeter. I said sure, we had a real nice one, good for up to 15 watts. He laughed, saying he needed one to read 3000 (yes, three thousand) watts. Another wishes to trade his 300 watt (output) linear on a high-power one. They don't like our standard line of antennas, because they are and melt at over 500 watts of rf. If this was the kind of customer I got once a month, or even once a week, I would be impressed with the integrity of CB radio, for I know of a few hams also running, 5, 10 or more kW. But this is the kind of customer I get once or twice a day on a slow day, and more often on busier days.

What is the solution? Can the FCC move CB to VHF where it belongs? I doubt it. Many do not have licenses, 98% do not use them (they just use pseudonyms – Poptart, Dumbell, Sandbox), and would pay zero attention to any FCC ruling saying "Ok, boys, be good and move up to VHF." Therefore, a reallocation of CB to VHF would result in two Citizens Bands, one legally allocated on VHF (but probably illegally used) and the other illegally retained by the ones who don't give a darn.

One solution would be to move them, and immediately reallocate 11 meters to international broadcasting, military point-to-point wideband multiplex, facsimile, multikilowatt AFSK, etc.

Another solution, one which might in the long run benefit amateur radio would be for special permission from the FCC for technically qualified amateurs, preferably holders of high class amateur *and* commercial tickets, possibly retired, who have the equipment, to act as volunteer monitors for the FCC. As most of us are aware if we sit and tape a conversation on CB and send it to the FCC, it is not admissable as evidence. But, for this special group of amateurs who wish to see amateur radio continue, they would be acting as official FCC monitors, on a voluntary, non-paying basis, and tapes and other evidence made by them would be acceptable to Federal authorities. This would cost the FCC nothing (one of their hang-ups), would multiply their monitoring manpower and efficiency tremendously (again at no cost) and would increase the chances of survival for amateur radio.

I would invite comments on this second solution, as to whether it would seem feasible to the majority of concerned amateurs, and be worthy of drafting into a formal proposal to the FCC. If worthy, I would gladly relinquish any "copyright" and hope someone with the knowledge of legality and formal governmentese would draft and submit it.

I know of a couple of amateurs in the Dover area who would qualify (and I am not one as I do not have a commercial license), so I am sure there must be many in larger areas.

Opinons?

Ed Brooks Jr. W3GAB
Felton DE

The choice on 220, as I see it, is either you lose a good part of it to CB per the EIA proposals or else you share part of it with a hobby licensee. Which would you prefer, complete loss or sharing? I see no parallel between possible 220 use and the mess on 11 caused by skip operating and regulations which make almost every operator illegal. But, it's your choice . . . which do you like best?

Dear Wishy Washy Wayne Green,

Anybody who prints the pages right instead of sideways can't be all bad! Let's get those other improvements implemented. 2m FM? Why? It's expensive, you get only one band, coverage is limited, you can't get anyone to talk to you on repeaters, costs a bunch to put up your own repeater, and try and use someone else's repeater while mobile.

XX

The above letter arrived unsigned, but I know who it's from . . . the postmark gave him away. The postmark was "Northern Virginia." How about that? What else but your favorite and mine, the CIA? Who else could have such a ridiculously ambiguous address. And who in the CIA but an old ham-Mensa buddy of mine named Brad would write such complete hogwash? Lordy, when you can buy a brand new transceiver for under two bills (like the Drake TR-22) and have an absolute ball, or even go the used Motorola route for less, they sure must not be paying much to the CIA agents these days. With his crummy attitude I don't doubt for a minute that the fellows in Washington across the river there won't let him into their repeaters. Good going, men, keep those cloak and daggerers in their compound and let them put up their own repeater with a super secret tone burst entry. Considering the crowds on 2m FM these days, who needs another band? I have all I can do to keep up with the FM scene. Oh, I come down for some choice DX now and then on 20m, but the excitement is on 2.

73 is usually several months ahead of local info on the IC scene.

We have in operation at the moment a repeater on Mt. Tambourine with an input of 146.1 and output of 145.6. This gives us coverage of Brisbane and the Gold Coast extending into northern VK2.

146.0 is our main working frequency for simplex.

Graham Nixon VK4ZZG
Brisbane, Australia

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor. . .

NEW ENGLAND ONLY: Swap new Drake R4B.MS4. for a Johnson 6N2 Thunderbolt amplifier. Jim Gysan W1VVB, 53 Lothrop St., Beverly, Mass. 01915.

2-METER FM IC-20 Brand new, solid state, 12 channel, Xtaled for four, 1&10 watts, module construction, with mike, m-mount, & cables. $225. K7NHE 15112 SE 44th, Bellevue, Wa. 98006.

MERRY XMAS AND HAPPY NEW YEAR from WØCVU. On the air since 1913.

10,000 PC BOARDS. Loads of transistors, diodes, pots. Sample 35¢, 10 for $2.50, 100 for $19.00. Bill Tatroe W5LCU, 6325 Beverly Hill, Houston, Tx 77027.

ELIGIBLE VETERANS build and keep a 25-inch Heath solid state color TV as part of a Bell & Howell (DeVry) home study course. GI-Bill pays 100% of the course and kit costs. Contact Bill Welsh (W6DDB) 234 S. Orchard, Burbank, Calif. 91506.

COLLINS MECHANICAL FILTERS. 455 KC IF, 1.2, 1.5 and 3.1 Kc @$20.00, 4.0 and 6.0 Kc @$15.00. Send SASE for complete list of part numbers. Two Eimac 4-1000A's and SK-510 Socket $50.00 the lot. Send check or money order to Richard Solomon, 19 Pierce Road, Watertown, Massachusetts, 02172.

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COLOR ORGAN KITS $7.50. IC Power Supply Kit $2. IC's $.25. Computer Grade Electrolytic Capacitors $.35. XMTR Transistor TRW PT3690 $1. Used Variacs. Nuvistors. Catalog. Murphy, 204 Roslyn Ave., Carle Place, N.Y. 11514.

MOHAWK receiver $150, KAAR FM40A receiver $25, 2 KAAR FM177X xmtrs $30, BC348H receiver $45. W7INR/6, 360 Sharry Lane, Santa Maria, CA 93454.

PUNCH THROUGH THE QRM, get 10 DB talk power boost with AMPRESS speech processor. Only $39.95. C. E. Cox Company, 2415 S. Broadway, Santa Ana, California 92707.

ROCHESTER, N.Y. is again Hamfest, VHF meet and flea market headquarters for the largest event in the northeast, May 13th. Write WYN Hamfest, Box 1388, Rochester, N.Y. 14603.

ALMOST FREE. Taped code lessons. Beginners to 5wpm. Refundable deposit on tapes, $1.00 for postage. Tomlinson College Radio Club, 3637 West Grandview, Tacoma, Wash. 98466.

NU SIGMA ALPHA International Amateur Radio Fraternity. Look to Advertisers index for space ad.

HOOSIER ELECTRONICS. Your ham headquarters in the heart of the Midwest where only the finest amateur equipment is sold. Authorized dealers for Drake, Hy-Gain, Regency, Ten-Tec, Galaxy, Electro-Voice, Shure. All equipment new and fully guaranteed. Write today for our low quote and try our personal friendly Hoosier service. Hoosier Electronics, Dept. D, R.R. 25, Box 403, Terre Haute, Indiana 47802.

CANADIANS, Japanese gear. LOW, LOW prices. Free catalogue and information. Glenwood Trading Co., Dept. A, 4819 Skyline Dr., North Vancouver, B.C.

FCC "TESTS-ANSWERS" . . . Original exam manual for First and Second Class License – plus – "Self-Study Ability Test." Proven! $9.95. Satisfaction Guaranteed. Command, Box 26348-S, San Francisco 94126.

ONCE IN A DECADE! Call it Christmas Special, year end closeout or what you choose. Look these bargains over and act fast. Drake 2B/2AQS/Xtal Calibrator $189; Hallicrafters SX100 $99; Hammarlund HQ110 $89; HQ170C $139; HQ180AC $239; National NC300/Speaker/Calibrator $109; RME 4350 $69. Drake 2NT $89; Heath HW 12 $79; National NCX5 MK II/NCXAXCU 27 $329; Swan 500 $289. Ameco TX 62 $79; Swan TV2B $199; Swan 250C $249. Drake T4XB/R4B/AC4/MS4 $795; Drake TR4NB $519; Galaxy 2000 Linear $199; Tempo 2000 linear $325. Many more items. Send for Complete List. Stan Burghardt, WØIT, Box 73, Watertown, S. Dak. 57201.

CRYSTALS for Regency, Varitronics, Drake, Swan, Tempo, and Standard transceivers and for police monitors. Receive - $4.50, Transmit - $5.50, postpaid. Many frequencies in stock. Quick delivery. DERRICK ELECTRONICS, Box 457B, Broken Arrow, Oklahoma 74012.

WANTED: Book "Practical Wireless Telegraphy" by Elmer Bucher (1917). Advise condition and price. Hugh Compton W7MKW, 205 S.W. 102nd St., Seattle WA 98146.

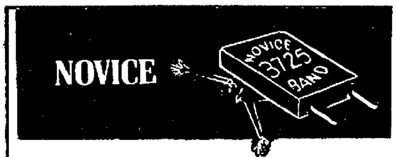
2-METER MOTOROLA P33-BAM HANDI-TALKIE, excellent condx, with nicads, Motorola charger, 12V cable, manuals, antennas, $150. Gary Goldberg WA2FAS, 4016 Coachmen East Apts., Lindenwold, N.J. 08021.

DRAKE 2-C, 2-CS, 2-CQ, 2-NT, Heath SWR Meter. Also xtals for international SWBC bands and three xmtr xtals. Excellent condition, like new, with manuals. Dream novice station; ideal for any brass pounder. First check for $340 gets free shipping. Mark Wilcox, Box 1357 Brown University, Providence, Rhode Island 02912.

WANTED: Socket and air chimney for PL5D22. Martell E. Montgomery K6HM, Apdo. 109, Ajijic, Jalisco, Mexico.

RELOCATING. NATIONAL NCX-500 with AC Power Supply. 500 Watts, 80-10, Sideband/Am/CW. Worth $524. Unused, original carton, with manual $324. Frank Hajdu, 41 Ledge Lane, Stamford, Conn. 06905.

FOR SALE, Two-Meter FM, Drake TR-22, Like New $125, David C. Toruta, 459 Eldon Dr., Apt.-29, Corpus Christi, Texas 78412.



Code Practice, Western Style

Don Johnson W6QIE sends code nightly except Monday on 3590 kHz at 8 pm local time, starting with 15 minutes of wpm, then 10 minutes each at 8, 11, 14, 17, 20, 25, and 30 wpm. Thanks to *Active Keys*, NPEC bulletin.

Novice Courses

The course being given by Bill Welsh W6DDB in Burbank has recently produced 27 Novices, most of them already on the air. The next course will start 5 June and run for 10 weeks. This is a tremendous course and well worth while. Write to LERC, Lockheed, Burbank CA 91504 with SASE for more data. Their General Class course will start 10 January and run for 18 weeks. The present class has 40 in attendance. These courses are open to anyone.

David Morgan K6DDO
4747 Ambrose
Hollywood CA 90027

Convert Your 7 MHz Cubical Quad To All Bands

Why let your quad limit you to one band? This is one antenna that can be adapted to multiband operation.

160 Meters

Let's start with 160 meters, since nobody ever heard of a rotatable quad on that band. Theoretically, it should be quite feasible to put the quad on 160. It would be likely to even have 2 to 4 dB of forward gain. Once you have built the large supporting structure it would be very easy to try 160. Here is how to do it. The boom length on the quad is 30 ft or so. On 7 MHz the boom length is about 0.22 wavelength. On 3.5, this would give about 0.1 wavelength spacing and on 1.8 about 0.05 wavelength spacing. At this spacing the antenna will be very sharp in frequency response and should be tuned to a spot frequency. However, it will still work and should display considerable advantage over the usual arrays. Generally about 0.1 wavelength is commonly used in close-spaced arrays.

For loading purposes, four coils of 3 or 4 in. diameter with about 4 to 6 windings per inch should be inserted in the center of the tops and bottoms of the element. (See Fig. 1.) The coils can be tapped and adjusted to tune the elements. The coil at the top of the element should be the same length as the one at the bottom. This will prevent imbalance.

The gamma match might be 15 to 20 ft long on 1.8 MHz; thus, the coils will have to be placed down toward the tips of the bottom wire. This can be worked out experimentally. The rule is to use the same number of turns on each of the two coils as close as you can get it. Also they must be the same distance from the center of the element. As you add one turn on the left coil, add one turn on the right coil and two

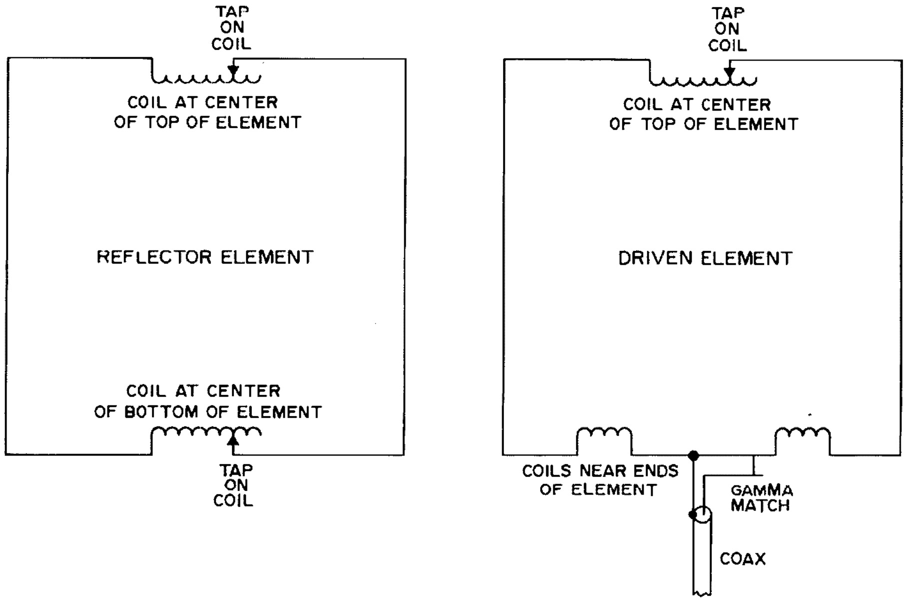


Fig. 1. Quad configuration, reflector and driven element.

turns on the coil at the top of the element. This way the array will stay in balance. There are other ways to accomplish the loading, but this is presented to give you the idea rather than an ultimate solution. Use a gamma match to feed the array. The electrical length of the reflector will probably be about 1.05 times that of the driven element. To tune the antenna first adjust the driven element coils and gamma to resonance at the desired frequency and then adjust the reflector coils for maximum gain or maximum front-to-back ratio.

80 Meters

If you can build a 160m quad then 80 should be easy. It is only a matter of loading. Use the coil system described for 160 but with less turns. The coils for 80 and 160 should be of rather heavy wire and widely spaced to prevent arcing under power. Long coils will be better and the diameter should be as large as convenient. The gamma match may come out around 10 ft long. The spacing of 0.1 wavelength is quite standard and will give excellent results.

20 Meters

From looking at the photographs of the original quad from which the multiband one was derived (73, May 1967, pp 26-31), you will see that the boom has four spiders on it. It is a simple matter to add four more pieces of element and have the entire support system for a 4 element 20m quad. The standard procedures can be used with standard measurements.

An alternative method to the standard 14 MHz quad is to add arms on the two spare spiders in the center of the boom and build a 4 element extended quad antenna.

Some of you are familiar with the K6CT crossed yagis. What George discovered was that you could mount two multielement yagis on one boom at right angles to each other and get a diversity effect and enhanced gain. Now you will notice that in the 7 MHz quad article previously referenced there is about 30 to 36 ft of aluminum in the center of each of the quad element supports. These are actually parts of 4 element beams for 14 MHz. The inner two elements can easily be added to effectively yield considerable gain. There should be virtually no interaction with the 7 MHz elements. To build it, just add a driven element in the center and another parasitic element. The spacing of about 7 ft between elements is about 0.1 wavelengths.

15 Meters

The 15m band is easy. Use the inner

spiders and build a 4 el quad. The spacing is wider than 14 MHz but still quite workable. You could also put in some 15m yagis. You could also build an 8-element quad on 15 in the configuration shown in Fig. 2.

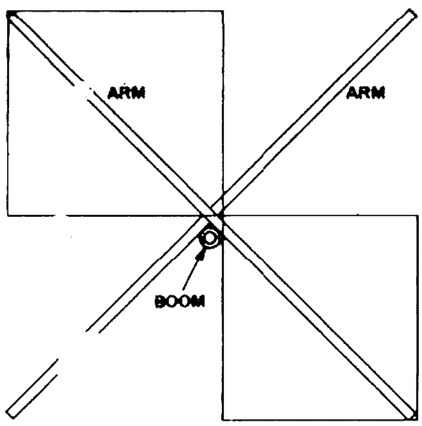


Fig. 2. Cross section of one spider and elements.

10 Meters

After all this you should have lots of ideas for 10. You can use any of the preceding and in addition you might try a quad-quad. This would give 16 elements or 28 elements with no more supporting structure than already described. A cross section of one spider is shown in Fig. 3. If you use four spiders like this you will have a total of 16 elements. However, on 10 meters the quad will have 0.2 wavelength spacing, which is sort of wide; this permits you to add three more elements between the existing four. There is no need to add more spiders because if you are clever you can hang the extra ones on nylon cord in between, taking care to get the spacing right and avoid wind movement. This 28 element quad on 28 MHz would really put out a signal.

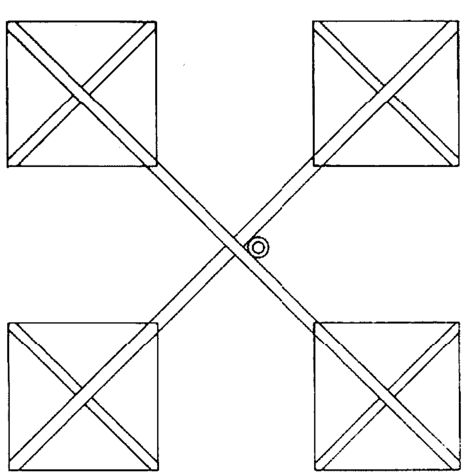


Fig. 3. The 28 MHz quad-quad.

The cross arms are not actually needed as the elements can be tied back with nylon cord.

All Bands

What is a simpler way to put all bands on the quad? The methods mentioned work best for high gain on one or two bands since the elements get in the way of each other if you try to add too many fancy arrays. For all bands it would be advisable to use straight quads on 28, 21, 14, and 7 MHz with four elements on the three higher bands and two elements on 7. 3.5 and 1.8 would be connected electrically by switching a relay.

Here is another idea for all bands. Suppose you buy two very strong oversize triband beams with sturdy elements. Then you mount them on the 4 in. boom and extend the tips of the four end elements with fiber glass or bamboo to 54 ft each. Hang your quad wires on for the lower frequencies and you will be ready to go. You would have a K6CT design for 14, 21, and 28 and a quad on 7. It might be necessary to build your own tribander to do this, since the commercial ones would not be sturdy enough. You can still add the coils for 1.8 and 3.5. What would be more practical on 3.5 and 1.8 would be to use traps in the quad elements and a multiband gamma with three gamma matches in parallel to cover all three bands. If you were to get a set of those traps used in trap dipoles you could probably work it out – maybe adding a few more coils as needed, here and there.

Switching

One of the ways to handle the feedline and switching problem is to use a stepping relay such as used on TV antennas. I took one of these and rebuilt it with coax leads inside it and it has worked out well on control switching of quad feedlines. One line runs to the shack. The relay has four positions and there are four feedlines pos-

sible to different antennas. Quite often the feedline of a second band can be ignored or phased out and a short length can be left in place with a relay 10 or 20 feet away. This is a matter for experiment with regard to the 3.5 and 1.8 MHz coils. The trap system might be the best for these low bands but what set of traps and coils to use if you try it is left to experiment. The point is that unwanted things can be disconnected with traps.

Feeding

Feeding a group of these antennas may be a problem. The standard types of matches will work well. But if you want to drive both a quad and a yagi on the same boom and same band this may be a situation requiring some thought to get the right impedances and good power transfer. I have found that gamma matches give the best feed for quads although many people don't use them. The idea of using coax baluns and calculated impedances does not give precise matching due to the reflections of nearby objects. It does work as a first approximation. The more bands and elements you add to the array the more important it is that you can tune and measure every part of the antenna.

Conclusion

What I have done is to give you some ideas that I hope will enable you to come up with some more interesting antennas and better use of a large supporting framework. The final method has not been described for there must be something left for experiment or we would not be doing much as amateurs. There are endless possibilities to getting more gain out of antennas and in a recent conversation with a professional antenna design engineer he told me that they could use some better ideas for the space tracking program. One of the important unsettled questions is how many arrays can actually be gotten to work on a design such as we have. Can you somehow cheat and squeeze in a few more elements and still raise the gain some more? Most people think you can't but they are the source of a new frontier.

. . .K6DDO■

The Indoor Quad

Ray Kasprzak K9RJO
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Chicago IL 60651

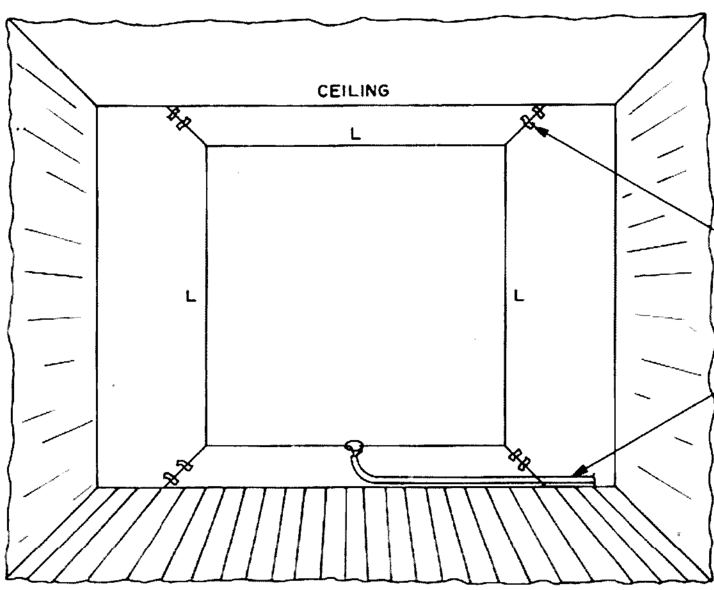


Fig. 1. Tie string at the corners and then tape to ceiling and floor. L = approx 251/f(MHz). I wound up with 8 ft 2 in. for each side after trimming for minimum swr.

After spending several hours on 15m with everyone telling me of the excellent openings on 10m, I decided to see if I could get some rf out on that band.

Being an apartment dweller, and having spent the entire summer erecting an inverted vee on the roof, I had my doubts as to whether or not my landlord would look kindly on my spending the winter putting up another antenna. (I would undoubtedly be seeking permission to erect an antenna on top of the local Salvation Army Hotel had I made another trip to the roof.)

That's when I decided to try an antenna inside the shack. First I thought of trying a dipole, but since a dipole doesn't really do much for my low-power signal even when the dipole is outside, I dismissed it. My next idea was a quad and looking around the shack I found that my ceiling was 8½ ft

high. Using the standard formula L=251/f, I made the driven element as shown in Fig. 1. I used string tied at the corners and taped the element to the ceiling and floor with the whole thing about 4 in. from the wall. Next, I made a similar element for the reflector and placed it 6½ ft opposite the driven elemenet (Fig. 2). I hooked up a 10 ft length of RG-58 to the driven element, and found I had an swr of 3:1. By trimming the driven element, I managed to

reduce this to 1.4:1. It's easy to keep the sides symmetrical by slipping the wire through the string. The string can be taped in place after trimming the antenna.

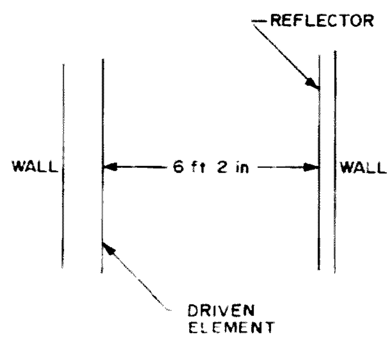


Fig. 2. The distance between the 2 walls of my shack was very close to the distance for optimum spacing. If you have room, you may experiment by trying various distances between elements.

The results were just a little short of amazing. During the first operating session with this antenna, I worked LUs, an HC, PY, 9Y4, XE and VE8. Signal reports were anything from S6 to S9+. I also worked a dozen W6s. Almost everyone said the band was on the poor side, and my signal compared favorably with others from the same area. The rig used was an HW-100.

The reflector is tuned to a frequency lower than that of the driven element. If you choose to have a director rather than a reflector, you should tune the element to a higher frequency than that of the driven element.

When switching from my inverted vee to the indoor quad, there is a 2 S-unit increase on the quad in all directions.

Incidentally, my operating position is right between the elements of the antenna.

. . .K9RJO■

Darrell Thorpe

Getting to know

TEE SQUARED 'ELL

The early RTL families of logic integrated circuits have been utilized for many ham-type circuits encompassing everything from rf amplifiers, oscillators, and other linear-type circuits to digital circuits for which they were originally intended. However, the commercial/industrial demand for RTL circuits has been on the downhill slide for the past few years so the availability, price, etc. are not as attractive as they have been; moreover, no new and exotic circuits have been added to the RTL families. But don't despair – get HEP with TTL, because this is where the computer industry demand is. And when you have big demand, you have high volume production which means low prices. In addition, you can do everything and a little bit more with TTL that you could do with RTL – and you can do it better, because TTL has much higher frequency capabilities. In fact, TTL is the fastest form of saturated logic made. MECL circuits which operate at higher frequencies are nonsaturating devices.

The basic gate of all TTL families is the *nand* gate; this is because all logic functions can be synthesized with only *nand* gates. A typical TTL gate circuit is shown in Fig. 1, and the typical transfer characteristic (input vs output voltage) is shown in Fig. 2. When all inputs are logic 0, the output is a logic 1. When all inputs are a logic 1 the output goes to a logic 0. Note, however, that the device goes through a linear region as it makes its transition from logic 1 to 0. By biasing gates in this linear region they can be used for amplifiers and other nondigital applications.

Notice from Fig. 2 that the permissible input voltage range for a logic 1 output is only a few tenths of a volt. This makes TTL a little more sensitive to stray voltages (noise) than RTL. It is possible that with power applied (pins 14 and 7) and with pins 1 and 2 open (or any of the other gate inputs) that pin 3 would *not* provide a logic 1 output (it would be at 0) because of stray voltage pickup. Grounding both gate inputs immediately produces a logic 1 output. So, don't attempt to use TTL gates with the inputs left open or you will have problems. In normal operation, the gates would be connected to another device which would provide the permissible input levels.

Basic Functions Using *Nand* Gates

Since we indicated before that the *nand* gate is the universal logic element of the TTL family, let's start out by showing how six basic Boolean functions can be implemented with *nand* gates. These are shown in Fig. 3. Some additional basic applications for *nand* gates driving discrete devices are shown in Fig. 4. Several of these circuits use the HEP-C3001P which is a slight variation from the basic *nand* gate in that it has open collectors which permits increased versatility. See Fig. 5. Note that the output transistor's collector must be connected to V_{cc} through a resistor, bulb, etc. As shown in Fig. 4, the open collector gate is ideal for driving SCRs, the new light-emitting diodes, and low-voltage, low-current incandescent bulbs. These last two items are often used as readouts in frequency counters.

Note: In all of the circuits shown, the V_{cc} and ground connections (pins 14 and 7) are omitted to simplify circuitry.

Pulse Shaping and Generating

Pulse shaping involves forming a train of square waves from any periodic wave. If the original waveform is relatively fast, 1 kHz or faster, the circuit of Fig. 6 can be

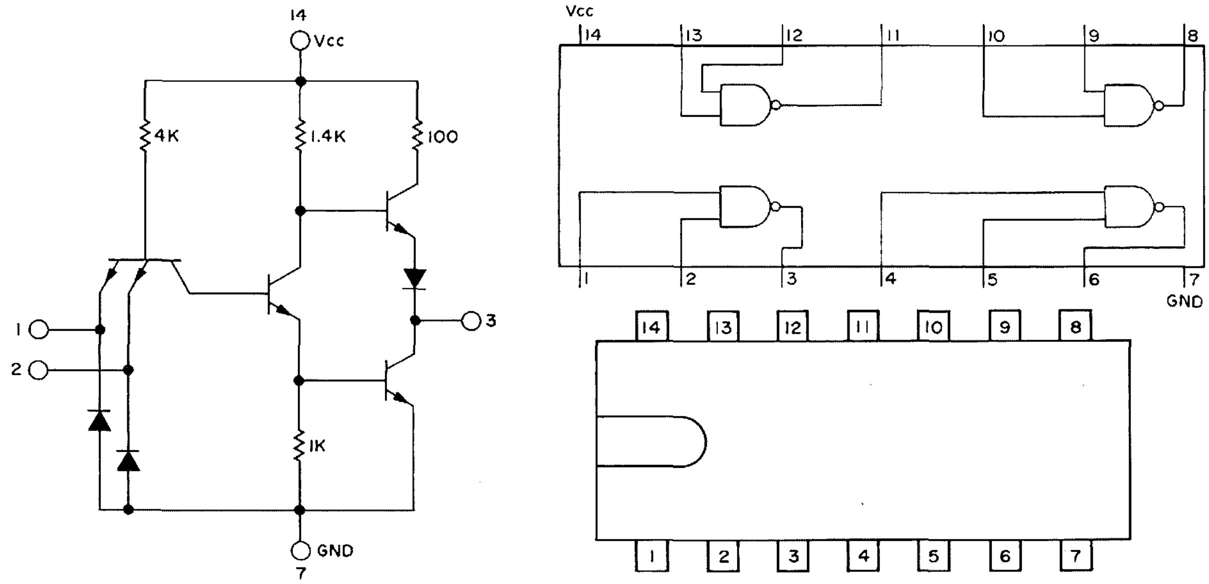


Fig. 1. Typical TTL gate (¼ of HEP-C3000P.

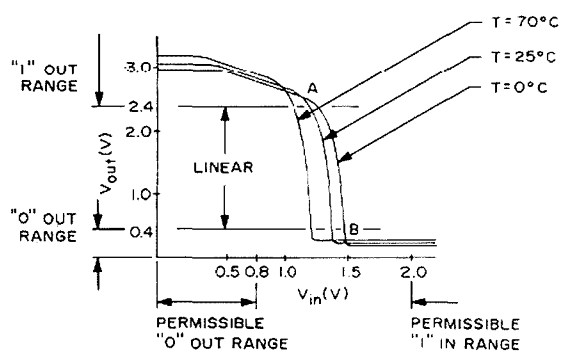


Fig. 2. Typical TTL gate transfer characteristics.

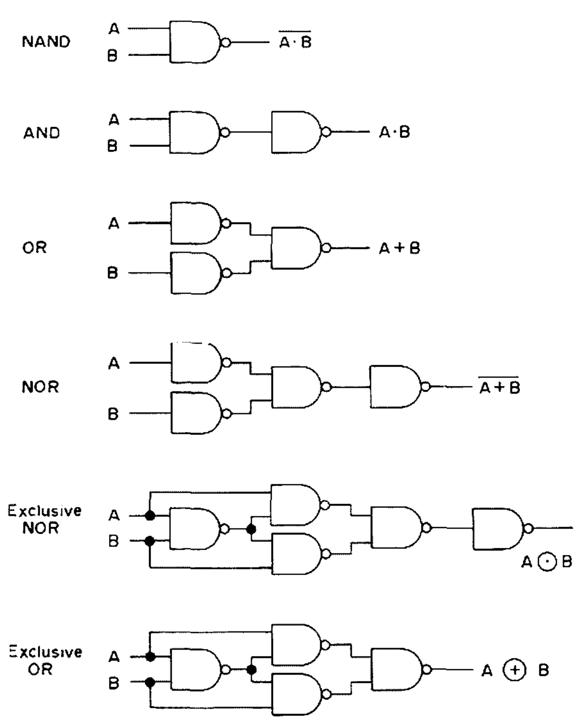


Fig. 3. Six basic Boolean functions as implemented with a NAND *gate.*

used to provide good square waves. Slower waveforms need the regenerative Schmitt trigger shown in Fig. 7. The accompanying table in Fig. 7 shows how the threshold voltages change with different values of R_F and R_{in}.

If the system already has an input square pulse, but of short duration, a wider pulse can be generated by using the input pulse to trigger a one-shot such as shown in Fig. 8. The chart gives values for C and R so that you can estimate the pulsewidth time in nanoseconds.

A square-wave generator with a fast risetime can be fashioned by connecting the HEP-C3001P as shown in Fig. 9. This is a ring oscillator with the external capacitor and load resistors controlling the frequency of oscillation. Frequency of operation for various values of R_L and C are given in the accompanying chart.

How To Linearize TTL Gates

The HEP-C3000P TTL gate can easily be turned into a linear amplifier; all you do is add some feedback. This is achieved by adding a 560Ω resistor between output and input, and a small resistor of about 220Ω in series with the input. This is shown in Fig. 10. The 560Ω feedback resistor biases the gates so that approximately 1V is provided at the output, which is in the linear region. A slightly smaller resistor will raise the output voltage level and a larger

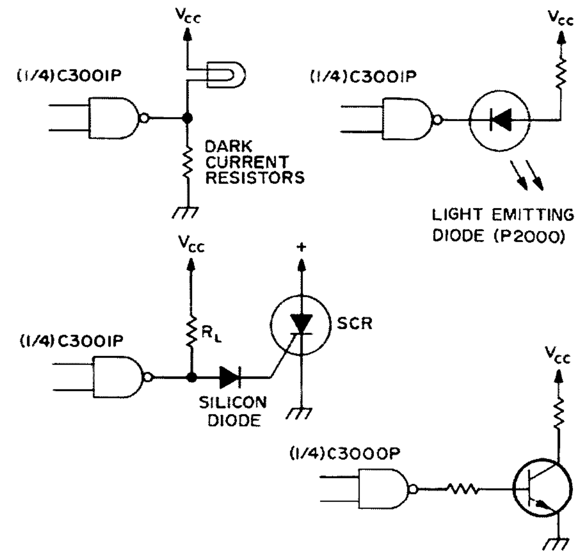


Fig. 4. Representative circuits of TTL gates driving readout lamps, SCRs and other discrete devices. The gate inputs would be connected to flip-flop or some other type of device to provide proper input levels.

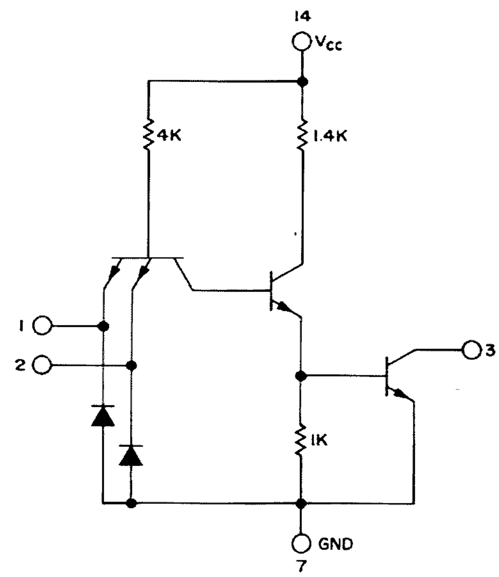


Fig. 5. Typical TTL gate with open output collector (HEP-C 3001P).

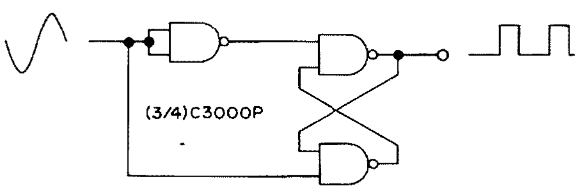
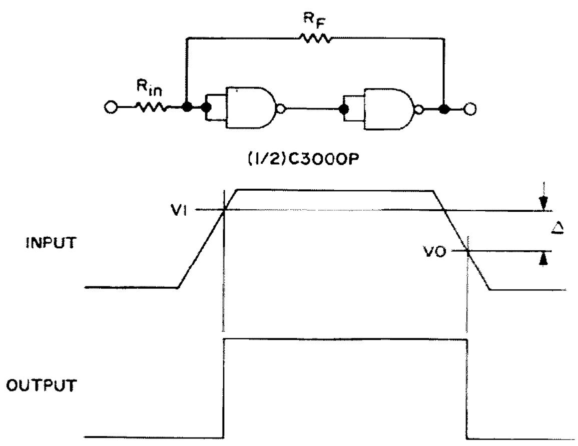


Fig. 6. Pulse shaper.



Rin (Ω)	RF (Ω)	VI (V)	VO (V)	ΔV (V)
300	4.0K	1.07	0.84	0.23
300	6.0K	1.04	0.89	0.15
500	7.5K	0.94	0.73	0.21
500	10K	0.94	0.77	0.17
500	15K	0.93	0.83	0.10
1.0K	7.5K	0.77	0.32	0.45
1.0K	10K	0.74	0.41	0.33
1.0K	15K	0.71	0.48	0.23

Fig. 7. Schmitt trigger.

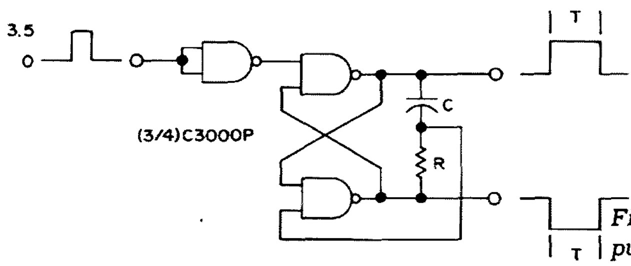
resistor (680Ω) will reduce output voltage to about 0.8V. With this simple arrangement, the TTL gate can be used as an amplifier for audio, video, and rf. As a broadband video amplifier this circuit provides fairly flat response over a bandwidth well into the megahertz region (around 9 MHz). With tuned circuits, it will provide useful gain to 30 MHz and beyond.

Two linearized gates connected in series provides a 360-degree phase shift which makes a perfect oscillator arrangement. As shown in Fig. 11, a crystal can be connected in a second feedback loop around both gates to provide an oscillator operating at the crystal fundamental frequency. This oscillator is good for use with crystals in the 1–20 MHz range.

A low cost square-wave generator that can operate from low audio frequencies up to rf in the 12 MHz range can be fashioned as shown in Fig. 12. The frequency of operation is controlled by C1 and R1. For fixed values of C1, the potentiometer can adjust frequency over a decade range.

Frequency Counters

The most widely used digital circuit is the flip-flop used as a counter. So, to provide a ready reference for all count functions from 2 through 10, we have developed the circuits in Figs. 13–21. Since the big reason for using TTL circuits is their improved speed over RTL, these are all synchronous counters. Synchronous counters require a number of interconnecting gates, but they are much faster than the ripple counter, which usually does not need the gates. The HEP-C3073P is a



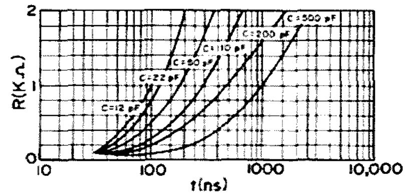
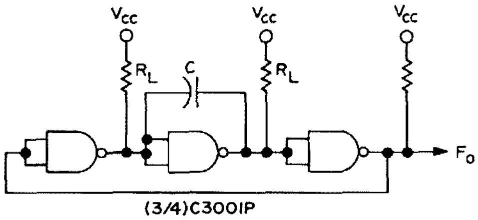


Fig. 8. TTL one-shot used to develop wider pulses. Chart shows values for C and R for various output pulse widths.



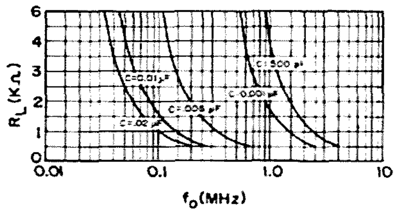


Fig. 9. Square wave generator (Ring oscillator). Frequency is determined by R_L and C as shown in the chart.

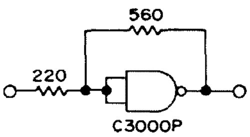


Fig. 10. How to linearize TTL gates with a feedback bias resistor.

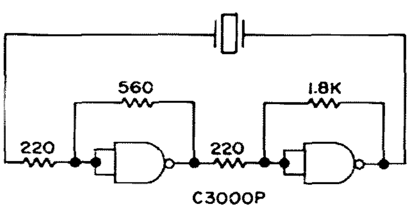


Fig. 11. Crystal oscillator using TTL gates.

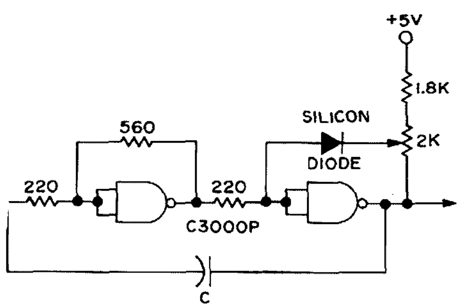
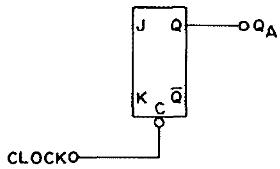


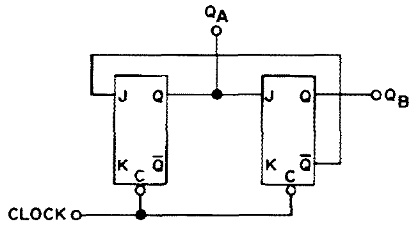
Fig. 12. Square-wave generator will operate over a wide frequency range from audio to RF. Capacitor and pot controls frequency.



STATE	Q_A
1	0
2	1

(1/2)C3073P

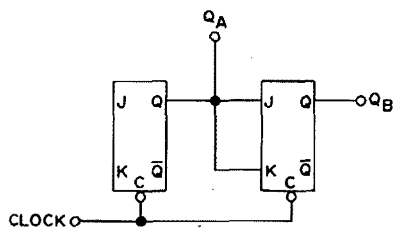
Fig. 13. Synchronous divide-by-2 up-counter.



STATE	Q_A	Q_B
1	0	0
2	1	0
3	0	1

(1)C3073P

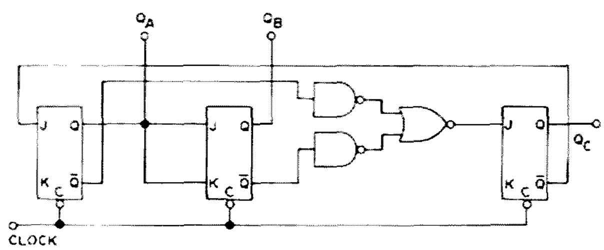
Fig. 14. Synchronous divide-by-3 up-counter.



STATE	Q_A	Q_B
1	0	0
2	1	0
3	0	1
4	1	1

(1)C3073P

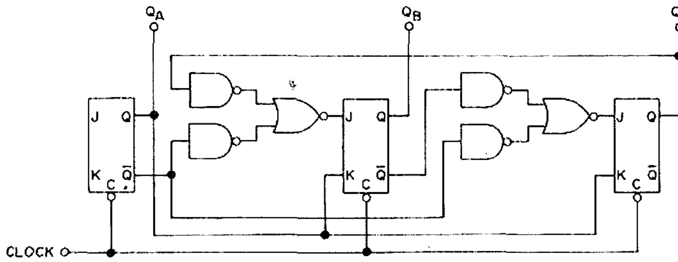
Fig. 15. Synchronous divide-by-4 up-counter.



STATE	Q_A	Q_B	Q_C
1	0	0	0
2	1	0	0
3	0	1	0
4	1	1	0
5	0	0	1

(1/2)C3050P
(1-1/2)C3073P

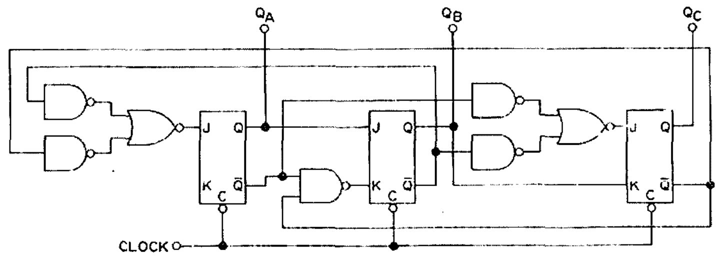
Fig. 16. Synchronous divide-by-5 up-counter.



STATE	Q_A	Q_B	Q_C
1	0	0	0
2	1	0	0
3	0	1	0
4	1	1	0
5	0	0	1
6	1	0	1

(1)C3050P
(1-1/2)C3073P

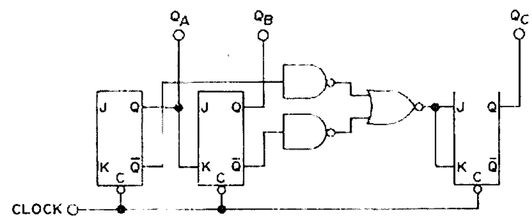
Fig. 17. Synchronous divide-by-6 up-counter.



STATE	Q_A	Q_B	Q_C
1	0	0	0
2	1	0	0
3	0	1	0
4	1	1	0
5	0	0	1
6	1	0	1
7	0	1	1

(1/4)C3000P
(1)C3050P
(1-1/2)C3073

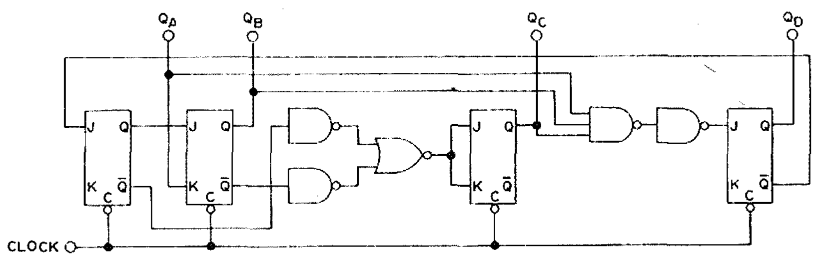
Fig. 18. Synchronous divide-by-7 up-counter.



STATE	Q_A	Q_B	Q_C
1	0	0	0
2	1	0	0
3	0	1	0
4	1	1	0
5	0	0	1
6	1	0	1
7	0	1	1
8	1	1	1

(1/2)C3050P
(1-1/2)C3073P

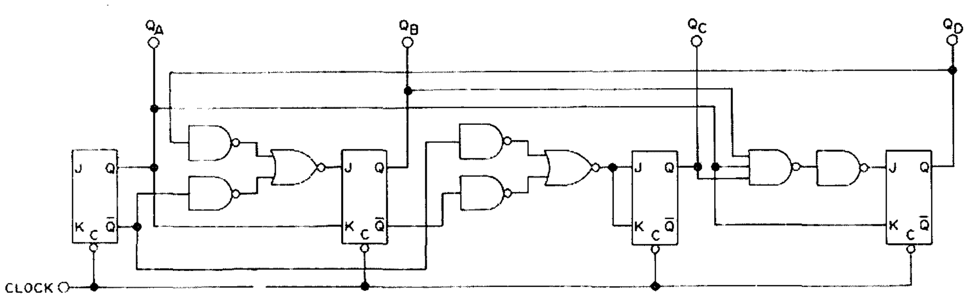
Fig. 19. Synchronous divide-by-8 up-counter.



STATE	Q_A	Q_B	Q_C	Q_D
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0
8	1	1	1	0
9	0	0	0	1

(1)C3020P
(1/2)C3050P
(2)C3073P

Fig. 20. Synchronous divide-by-9 up-counter.



STATE	Q_A	Q_B	Q_C	Q_D
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0
8	1	1	1	0
9	0	0	0	1
10	1	0	0	1

(1)C3020P
(1)C3050P
(2)C3073P

Fig. 21. Synchronous divide-by-10 up-counter.

dual JK flip-flop that triggers at frequencies up to 20 MHz. The HEP-C3050P is a dual 2-input *and-or*-invert gate.

All of the counters operate as follows: The counter starts in state 1 where all flip-flops are at zero. With each negative transition of the clock pulse, the counter steps to the next state in its table. From the last state in the table, the counter cycles back to state 1. The frequency of the pulses out of the last stage of the counter is equal to the input frequency divided by n, the number of states in the table.

. . .Thorpe■

Reference: TTL Design Ideas – Motorola Semiconductor Products Division.

More Power from 6146s

E. John Labaj W2YW
12 Park Place
Elsmere NY 12054

After some checking and minor circuit changes I found that I could run a pair of 6146s (A or B) at an input of 400 mA at a 1000V, and no sweat.

Observation and measuring indicated that some of the problem with the tubes was like one famous TV personality's drinking problem: He knew his limit but he always lost control before he reached it.

Same with the 6146s. Long before the input limit was reached the tube lost control, resulting in plate-current runaway and tube failure.

While the 6146 plate is about the same size as comparable sweep tubes, the 6146 seems more touchy, tending to gas and go into a catastrophic "spin" with very little provocation.

With the average circuit and biasing arrangement the 6146 tube will have about 20 to 30 kΩ resistance, plus the resistance of the bias supply between the grid and ground.

Now, with a minor tuning fluff, or even normal use, especially on the higher frequencies, and with a few loose electrons around, the 1 control grid will act as a cold cathode and set up a reverse grid current flow. This reduces the actual grid voltage from that coming out of the supply, which in turn causes more plate current, and thus more reverse grid current. In less time than it takes to tell about it, this cumulative action has cost you another pair of 6146s.

This is understandable when you see that the potential on the control grid is greater than that between the actual cathode and screen and plate.

To minimize the bucking effect of the reverse current I jumpered all resistors in the grid circuit with small low-resistance rf chokes. This reduced the voltage drop through the grid circuit string under current flow conditions, either forward or reverse.

To make sure of a stable bias supply I bought some surplus zener diodes and clamped the bias supply at -82V. This fed the hot end of the bias potentiometer, and then, as close to the actual grid as possible but on the cold (rf) side of the grid feed I used another zener diode which was -68V; this happened to be the value that was needed to set the plate current to normal idling (Fig. 1).

To make sure of getting sufficient peak plate current flow, I jumpered the screen feed resistor so that screen voltage was clamped at 260V. The series feed resistor was 1.2 kΩ; the B+ supply under load was 310V – this voltage was clamped by using two 10W zeners in series, as shown in Fig. 2.

To discourage the screens from getting into the secondary emission act, I wired in series with each screen lead a 1 kV, 1A silicon diode rectifier.

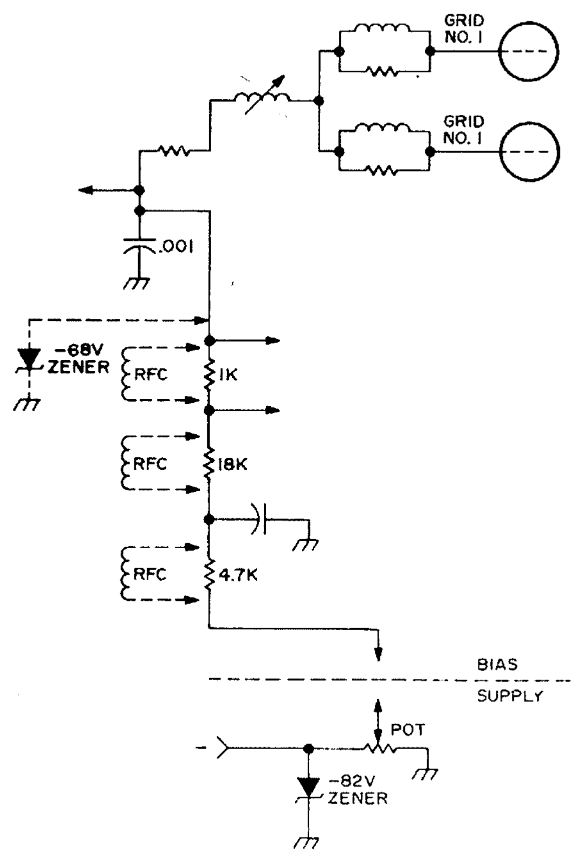


Fig. 1. The addition of zener diodes established a runaway limit. A -82V zener limits the bias output and a -68V zener clamps the grid potential.

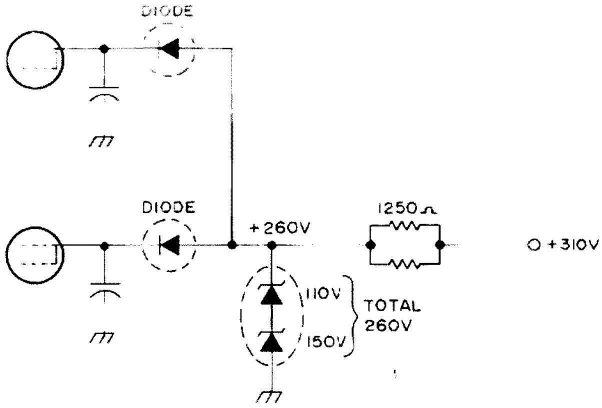


Fig. 2. Zeners can be used in series to help limit the B+. Make sure the diodes are rated to handle the dissipated power if you don't use resistors with them.

In case you need more drive, remember what Joe Namath says: You have to excite them to make them put out! You can juggle the bias and screen voltage on the driver tube – in my case, found that the 6CL6 had over 6V bias on the cathode – and for linear class A operation it should be less than 3V. I shunted the cathode bias resistor and also the screen feed resistor and again using a zener, I clamped the screen voltage at 150V. This gave me enough drive to get about 8 mA (maximum) grid current.

Before you start pouring on the coal, make sure the tubes are neutralized – and it helps if they are matched. Use a fairly sensitive rf indicator across a small 47Ω carbon resistor across the output.

Go over the neutralizing adjustment till you reach the best setting. That is, adjust for good grid current flow – then adjust the neutralizing capacitor for a dip – tune the plate for a peak – again adjust neutralizing capacitor for a dip – retune plate for a peak. By carefully observing the rf indicator you will find a neutralizing adjustment that results in the lowest peak when tuning the plate. That's the spot!

Do not load the 6146 too heavily without drive. In the CW mode at 400 mA it will take about 4 mA. In the SSB mode when kicking to 400 mA, the grid should wiggle 0.5 – 1 mA.

...W2YW■

Radio Direction/Range Finder

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Working ten years ago with loop antennas, I noticed that the so called "null" was rarely a null; in most cases it was just a sharp decrease in a signal strength. It was further noticed that by tilting the loop a real null became possible. The top of a hand-held loop had to be tilted toward you and away from the transmitting station.

This resulted in an interesting solution to the ambiguity problem; if you got the total null–you are facing the signal, if not–it is behind you.

This angle of tilt, necessary to produce a total zero signal, was and still is a mystery.

A direction finder consisting of aluminum aircraft loop, mounted on a small aluminum hand-held box, containing transistorized receiver (BC band, 80 and 40 meters) and batteries, was constructed. A pendulum was attached to the top of the loop to measure the angle of tilt.

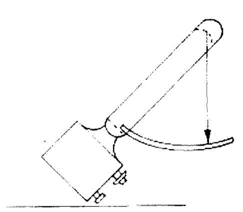
Tests, including a 100 mile diameter drive around a known station, showed a definite dependence of the angle of tilt on the distance to the signal source. The measurements were however complicated by variations in the angle of tilt (time of day, frequency, and possibly some other unknown factors). As far as I could determine (and I did not get very far) this is what probably happens:

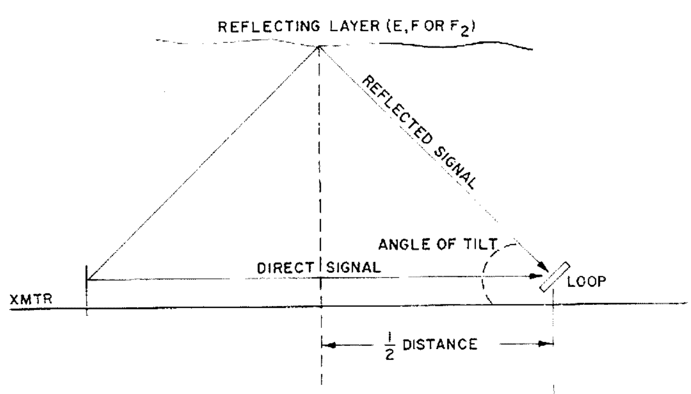
A vertically held loop cannot produce a total null because *two* signals are present–direct and reflected from one of the heavyside layers. Somehow these two signals can totally cancel themselves only when the loop is tilted, and in one direction only. It appears that the angle of tilt then is a function of two things–height of the reflecting layer and the *distance* to the station. If so, that distance can be found by a solution of a simple trigonometric problem involving a rectangular triangle with one side (height of the layer*) and one angle (angle of tilt) known.

Unfortunately it is not that simple. Which layer? What is its exact height at the moment? Is there a possibility of a third path?

I was able to calculate the distance with an average 40% error. The frequencies were BC, 4 and 7 mhz; all distances less than 100 miles.

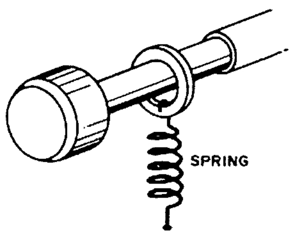
All this was done ten years ago; I tried to get people interested in this project, but only one person showed up to look at it. When I explained that a lot of developing is yet to be done, his face produced an





Vernier Dial Control

Through constant use, eventually many vernier dial movements begin to slip. By putting the shaft into a slight "bind," control can be gained again.



A thin wire or washer on the shaft held under slight spring tension, inside the set where it won't show, will give good vernier action again.

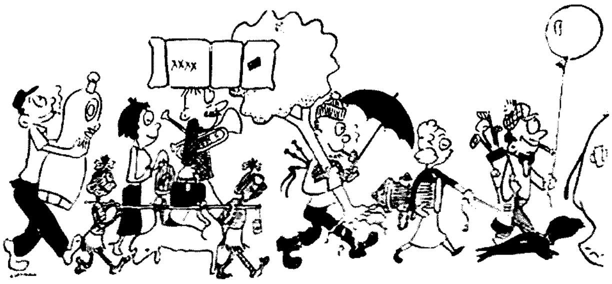
Richard Mollentine, WAØKKC

expression of a man in whose mouth suddenly materialized a dead rat beamed down from the "Enterprise."

Anyone want to take over where I left off ten years ago, do some experimenting, and become immortal? I am busy with my radio controlled submarine models, and gave up on this one.

... K6BIJ

*If my assumption that the "angle of tilt" is a function of the height of the reflecting layer is correct, then this height can be measured by solving the same trigonometric problem. In this case we measure the angle of tilt necessary to produce the "null" in a signal coming from a station located a *known* distance away.



Moving? Please let us know.

OOPS!

K6MVH's "Gain Antenna for VHF/UHF Repeaters"(73, July, 1971, page 42) is not really so non-critical that all dimensions can be left to the reader's imagination. Neither can it be said that we purposely deleted the dimensions to test how alert our readers really are. Actually, somebody goofed and forgot to put the dimensions onto Figure 1. The dimensions for this antenna are: 2 meters: A = 19", B = 13.3", C = 26.6". **450 MHz**: A = 6.33", B = 4.44", C = 8.875". **220 MHz**: A = 12.66", B = 8.88", C = 17.75". Note also that the bottommost coaxial section in Figure 1 is incorrectly identified as "C" length. It should of course read "B", as is clarified in the caption.

Ken W. Sessions K6MVH

Curtis CW Identifier

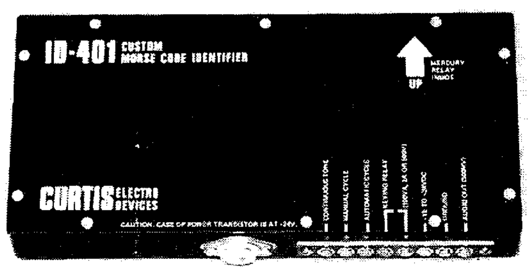
When repeaters started getting very popular and manufacturers began to tool up their assembly lines for production of 2m FM transceivers, a representative of Curtis Electro Devices called me to ask what the potential might be for a repeater ID unit. Curtis has been manufacturing electronic keyers for some time, and the switchover to an automatic ID unit seemed logical enough. It seemed to me that the market could certainly afford at least one manufacturer in the identifier field, provided that the manufacturer could afford to produce the unit at a cost that was within the budget of the average repeater group.

The Curtis people were not too involved with repeater operation, but they wanted to make their identifier solve all the problems associated with automatically identifying repeaters; so the representative listened while I listed all the desirable features such a unit would have – which were considerable. Within two months, I opened a package that came in the mail and found what I consider to be the ideal identifier. Curtis had taken the ideas I'd given and combined them with some of their own, and the result was a working production ID unit that can be easily installed into any repeater within minutes. What's more, the Curtis identifier contains in its one small package all the control circuitry, tone oscillator, and relay contacts required to make the unit immediately operational.

When properly connected into a repeater, the identifier will send out a modulated CW signal when the first carrier appears on the repeater input. From that point on, it will identify at three-minute intervals as long as the repeater is being used. When all the carriers drop out and the repeater is no longer being accessed, the Curtis identifier will send out one more ID at the end of 3 minutes, then it will keep quiet; and it will remain quiet until someone else comes along and uses the repeater.

The unit has a built-in speaker so that you can hear the ident when you are testing or installing the system. And an inside-mounted switch allows you to cut off the speaker when you're through making checks. The unit has a set of relay contacts built in, too. These contacts stay closed during the time the identifier is generating its signal; they are used to lock the repeater transmitter on during an ident so the identification signal won't get cut off in mid-sentence.

Other features include a volume control to adjust the level of the modulated CW signal into the repeater transmitter, a speed control to adjust the rate of the automatic identification signal, and various terminals to change the mode of operation from "automatic" to "manual" – or from periodic keying to keying each time a carrier appears.



The Curtis ID package. The terminal strip gives access to all control, voltage and ground points needed for fully automatic operation.

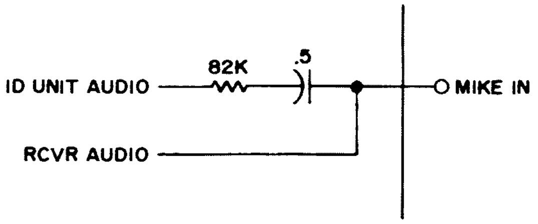


Fig. 1. A series resistor/capacitor network in effect increases the impedance of the ID unit's audio output, and prevents circuit loading.

The Curtis automatic identification unit should be compatible with most repeaters, because it uses a negative dc voltage (12–28V) for control. A ground signal, as from the carrier-operated relay, keys the identifier, but does not cause triggering of the ID until the required time period has elapsed.

When I connected the identifier into the WA1KGO repeater, I noticed that the audio from the Curtis unit tended to swamp the audio arriving from the receiver. This situation resulted in repeater users being jammed out by the identifier. I placed an 82 kΩ resistor and a 0.5 μF capacitor in series with the audio lead from the identification unit (Fig. 1), and that solved the problem.

I didn't do a great deal of thinking or planning before I connected the ID unit initially, and I ended up paralleling the ID unit's contacts with those of the transmitter PTT. This is an acceptable scheme, but it resulted in an automatic identification every three minutes, day and night, even when the repeater was not in use. This was because of the small bias voltage on the PTT line. If you like to sleep with your monitor receiver on, you'd be driven quite mad with this sort of hookup. I know I was. So I raced up to the hilltop and made a few small control-circuit changes; the final interconnect circuit is shown in Fig. 2. This latter arrangement keeps the unit from generating an ID signal unless the repeater is actually being keyed, but it does not keep the unit from finishing its ID once it's started, even if the incoming carrier drops out.

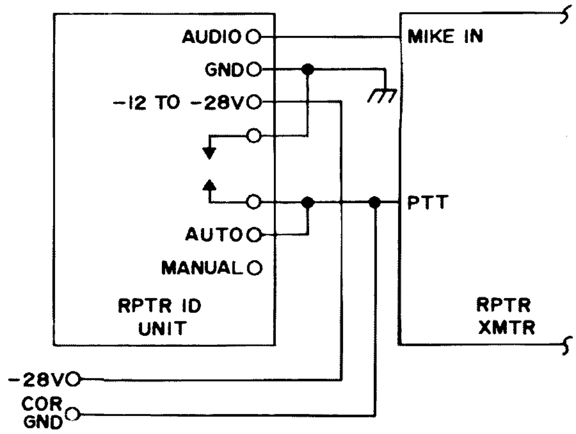
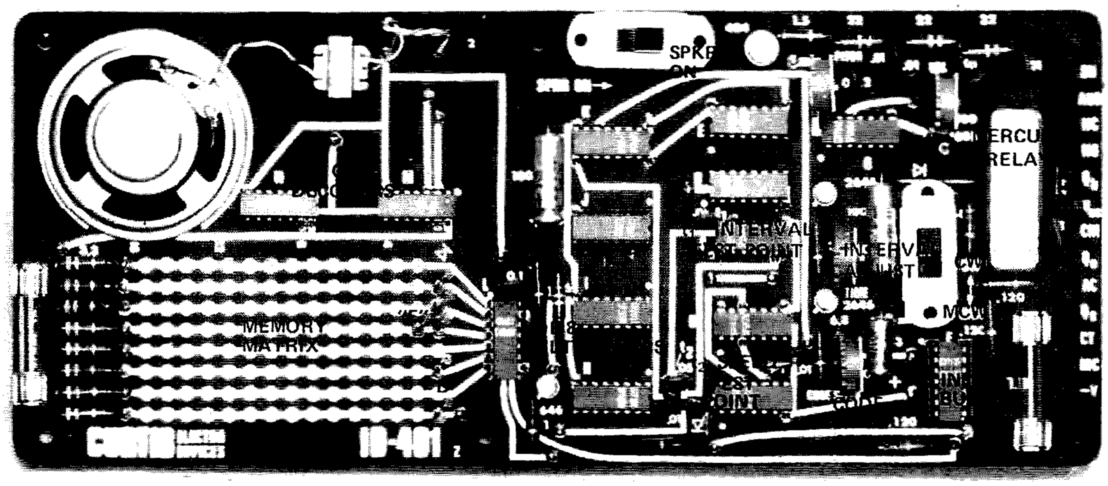


Fig. 2. This interconnect scheme allows identification only when repeater is in use.

Technical Aspects

The block diagram (Fig. 3) can be used to follow this operational description. When a signal from the carrier-operated



Inside the Curtis ID-401. A PC-mounted speaker (upper left) allows monitoring of the audio signal even before the ID unit is connected to the repeater. The memory matrix (below speaker) can be programmed or reprogrammed by amateurs in the field. The matrix shown is programmed for "DE" only, as indicated by the diode placement.

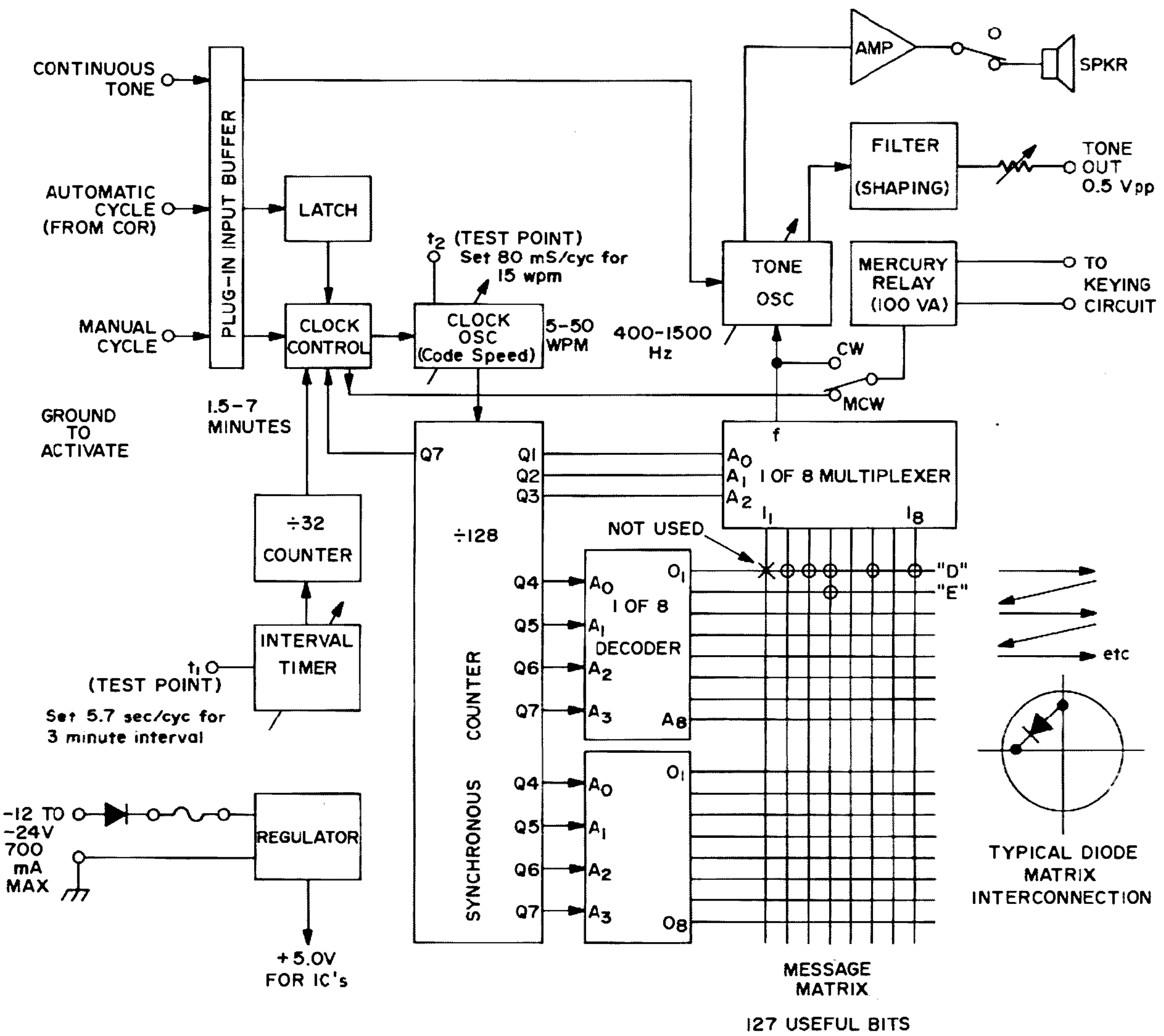


Fig. 3. Block diagram of Curtis ID-401 identification unit.

relay in the repeater grounds the "automatic cycle" input a latch is set indicating the closure regardless of duration. For the first closure after the repeater has been at rest, the clock control starts the clock which is fed into a ÷128 counter. This counter is fed to two 1 of 8 decoders and one 1 of 8 multiplexer. The decoders ground the horizontal matrix lines in sequence starting at the top and proceeding downward. Each line is held low for eight clock cycles.

At the same time, the 1 of 8 multiplexer is scanning the vertical lines – acting in effect like a single-pole, eight-position switch. In this manner the matrix is scanned bit by bit from the upper left down to the lower right.

Each intersection between the vertical and horizontal lines which is connected by a diode pulls the input of the multiplexer low. Each "low" is interpreted as a dot; three in a row is a dash. Where a diode is not connected, the output represents a space. In effect, the memory plays out just like a paper tape. You can read the message by examining the diodes. Programming or reprogramming requires only a knowledge of Morse code and no knowledge of Karnaugh maps.

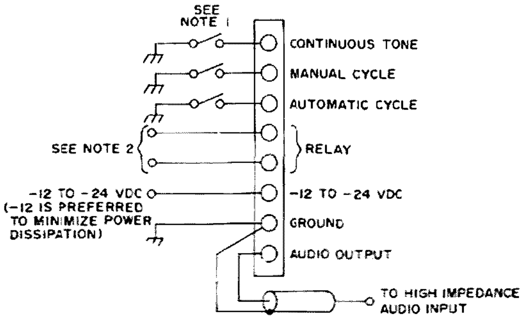
The memory plays out one time and stops until the interval counter counts out the set interval at which time the program will play out once more. If the repeater has been activated during the waiting period the timer will again count out a set interval and cause the unit to identify once more. Only when an interval passes without repeater activation will the unit cease identifying. And at the same time, the unit will not ID *more often* than the set interval

regardless of what is happening at the repeater.

The interval timer is a unijunction oscillator followed by a +32 counter to obtain reliable long time intervals over temperature and independent of line frequency (in case the unit uses batteries for standby).

Activation of the "manual cycle" input causes continuous IDing. Activation of the "continuous tone" input gives a continuous audio output. These three controls are all buffered by a plug-in IC since improper hookup may damage the input ICs. The IC is easily changed in the field. The unit is protected against reverse polarity. A fuse (and a spare) is also provided.

The output of the multiplexer drives



1. THESE CONTACTS SHOULD CLOSE WHEN THE REPEATER IS COMMANDED ON. THESE CONTACTS MUST NOT BE ON THE REPEATER CARRIER KEYING RELAY.
2. TO KEY CARRIER, USE DIODE ARC SUPPRESSION WHEN DRIVING RELAYS. ALSO R/C SUPPRESSION. SEE CHART.

Fig. 4. Terminal strip of the 401. Internal controls are set as follows at factory: Speed, 15 WPM; Time, 3 minutes; Pitch, 650 Hz; Volume, Full; Speaker, On. Relay Mode, MCW.

both the MCW oscillator and a mercury reed output relay. The relay may be switched to either a CW (keys the Morse) or MCW (key down during whole program) position.

The audio drives both a switchable internal speaker and is filtered and level controlled for directly modulating the repeater carrier.

The interval timer is variable between 1.7 and 7 minutes, the speed from 5 to 50 wpm and pitch from 400 to 1500 Hz.

The regulated power supply allows operation from –12 to –28V dc and draws about 700 mA.

The unit employs 14 ICs, three of which are MSI types. ... K6MVH

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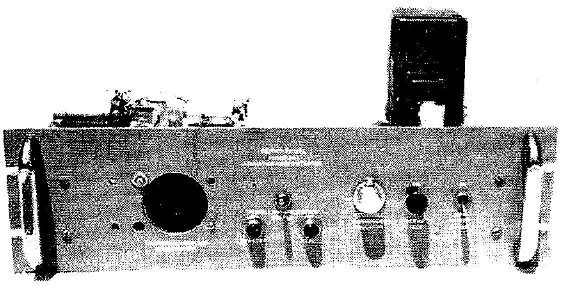
MORSE MEMORY

All of the Morse code message sending devices which have been in the amateur radio magazines have been designed to send one short message over and over again, usually for repeater identification. They all have been useful for one limited application and have lacked the versatility that is possible using some of the newer advances in integrated circuit technology. The Morse Memory is capable of sending a message in code at any speed as many times as desired. The distinctive difference is that the message in the memory can be changed in a matter of seconds by a simple programming process.

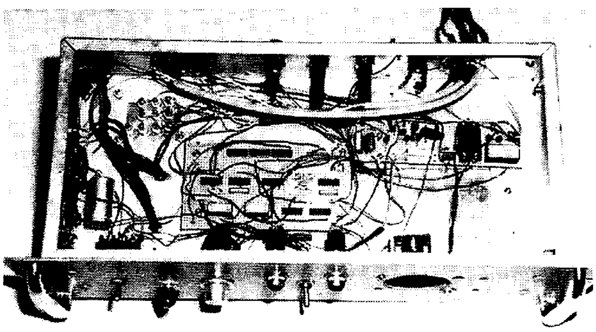


The controls from left to right are memory select, speed control, audio volume, power. The speaker is at the far left, and two power supplies are mounted on the top.

With the encoding scheme used here, a message up to 30 letters long can be stored in the Morse Memory, depending on the length of the letters in the message. This is more than enough to handle any message needed in a contest-type operation and it is also sufficient to send messages during normal daily operation. For example, the Morse Memory can be used during a contest to send repetitive messages such as CQ FD CQ FD DE WA6ATT/6 K. With the simple addition of another integrated circuit memory,. two different messages can be sent. For instance, the alternate memory can be used to store the message DE WA6ATT/6 599 LA LA K, sent directly after you send the call of the station which you had just contacted. To send either of these messages you must only push one button and the Morse Memory will do all the rest. On the last Field Day our group used the Morse Memory for every CW contact and it now seems difficult to imagine how we operated CW in contests before. It took care of about 90% of all situations which we encountered. Since the Morse Memory does not hold any message permanently, for the next contest two different messages can be programmed into the unit.

The Morse Memory uses an integrated circuit random access memory (RAM) instead of the large diode matrices used in many of the other projects. Each IC memory

can hold the same amount of information as a diode matrix containing hundreds of diodes. These memories were first produced less than 5 years ago and are now being used in the newest computer systems. The price for individual units has just dropped to the point where they are economical enough for amateur use. The particular memory element used in this project is the Intel type 1101 MOS large-scale integration device. It is capable of storing 256 bits of binary information in a 16-pin dual inline integrated circuit package. Unlike the rest of the logic in the Morse Memory which uses regular P and N type silicon construction as in regular transistors, the memory chip is constructed from silicon and silicon oxide such as is used in MOS FET's. To give some idea of the degree of miniaturization involved, there are over a thousand of these FET's in each memory chip.



The main IC board is in the center with the transmitter interface in the upper right. The third power supply is mounted on the left wall.

Inside the 1101 there is a memory plane of 256 bistable latches arranged in a 16 x 16 matrix. Each latch must be in one of two possible states at any one time. These two states are normally abbreviated 1 and 0 to represent a high voltage or a low voltage. It is possible to *read* that is, to find out which state a particular location is in, and it is also possible to *write* which involves changing the information in the latch to that of the input signal. Since there are 256 bits of memory, any number from 0 to 255 will correspond to a different memory location. This number is put on the address leads to single out the memory location wanted. All of the necessary decoding is done inside the memory chip itself. For instance, if you wish to read the contents of location 157, you would simply put that number on the address leads and observe the DATA OUT lead. Since the device can understand only binary information, that number must first be converted into binary. It takes eight binary digits to differentiate between 256 different locations; in this example location 157 corresponds to binary 10011101. Although it seems difficult to decode all of these numbers, it happens that there are relatively simple devices which take care of this problem.

All the rest of the circuitry in the Morse Memory is transistor-transistor logic or TTL. This type of logic is used far more in industry than the RTL devices which have been most common in previously published projects. TTL has many advantages over its RTL counterpart; these include high speed, reduced power dissipation, and lower output impedance. For instance, the entire IC portion of the project which includes over 2500 transistors requires only 1.7W and is capable of sending a message at around 1 million words per minute. The particular type of TTL used was the 7400 series. Each member of the series is designed to be compatible with the other members of the series. In addition, there are at least five companies which make their own versions of the 7400 series, each of which is designed to be compatible with units produced by another company. The larger companies producing a 7400 series are Texas Instruments, Sprague, ITT Semiconductor, Motorola, and Philco. Because of its completeness and availability, I used the TI series. The basic internal differences between TTL and RTL are that TTL inputs of *nand* gates are multiple emitter connections to a single transistor instead of connections to bases of different transistors in RTL, and the outputs of TTL gates are pulled up to plus and pulled to ground by different transistors instead of just having the output pulled to ground and a resistor to plus in RTL

In order to understand the operation of the unit it is not necessary to understand the internal operation of each device. The only thing which must be considered is the truth table, or mathematical description of each chip. *Nand* logic is used in the system, and the only fact which must be remembered

about these devices is that a 0 signal on any input forces a 1 output. Whenever all inputs are 1's, the output is then zero. In addition, whenever any input pin on the TTL devices has no connection to it, that pin is considered to be in the 1 state.

The most common arrangement of *nand* gates in this project is called the bistable latch; there are over five hundred of these latches in the entire project. Three are outside the memory chips and must be wired, so they should be understood. They could be considered the digital equivalent of a child's seesaw. Just as one end of the seesaw must be in the air and the other on the ground, if one output of the latch is high then the other is at ground. To put a particular end of the seesaw in the air you must push on the ground. To put one output of the latch to a high state a negative pulse, that is, a pulse to ground, must be applied to the input of the *nand* gate whose output needs to be changed. If the pulse is applied while the output is already high then nothing will happen. If the seesaw has a weak center pivot, when both sides are pushed up the center will break, and both sides will go high. If both inputs are grounded, both outputs will go high.

Aside from the *nand* gates and inverters in the Morse Memory, there are three other different TTL devices: one-shots, divide-by-16 counters, and shift registers. The action of the one-shot is basically simple. It gives a pulse of a predetermined length at the output whenever there is a negative going edge of a pulse at the input. The one-shot will not fire again until the input signal goes positive and then goes negative. There is inverting action in the device so both a positive and a negative pulse is available at the two output terminals; the terminal with the positive pulse is Q, and the one with the negative pulse is $\bar{Q}$. There are two timing terminals to set the length of the pulse by a resistor and capacitor combination. With the values shown the pulse length is about a millisecond, long enough to detect easily, but short enough so that it will not conflict with the other signals.

Internally the one-shot is fairly simple with only a flip-flop and a pair of gates; the other two devices are a bit more complex than the one-shot but not as complex as the memory. They are therefore known as medium scale integration or MSI devices. Each of the four chips contains four flip-flops internally wired in slightly different ways.

The divide-by-16 counters has each output of the flip-flops connected to the clock input of the next flip-flop. In this way each flip-flop divides by two for a total division of 16. Each of the outputs of the flip-flops is available at a different pin on the package, and with the divide-by-16 output of the first chip connected to the input of the next chip, a clock input to the first chip will be divided by 256 at the output of the second chip. These two chips have a total of eight outputs each at a frequency which is one-half of the preceding signal. If the counters are first reset and a clock signal applied, the devices will count from binary 00000000 to binary 11111111, that is, from 0 to 255. These signals are exactly what is needed to address the memory.

The four bit shift registers each have four flip-flops connected in a slightly different arrangement. The Q and $\bar{Q}$ output of the preceding flip-flop are connected to the J and K inputs of the next flip-flop. With the clock leads all connected together the end result is that the information contained in the preceding flip-flop is transferred to the next flip-flop whenever the clock line is pulsed. With two of these devices connected together, information which is put on the input will be at the output of the last flip-flop exactly eight clock pulses later. This is the digital equivalent of a delay line. As in the counters, each flip-flop has its output available to use. If the input of the shift register is connected to the message output of the memory, and the address to the memory is changed at the same speed as the shift register is clocked, then the last eight bits of message are always contained in the register.

The Morse Memory simply contains the devices mentioned hooked up to perform the required functions. There are many ways to encode the message in the memory, and the peripheral circuitry of the memory will be entirely different with different coding schemes. Here perhaps the simplest method of coding was used. It is a simple time-based

code where a dah is represented by three ones, a dit by a single one, a space between dits and dahs by a zero, and a space between characters by three zeros. The space between words is a matter of personal choice; either 5 or 6 zeros will suffice. If the message is coded in the memory in ones and zeros serially from location 0 to as high as needed by the length of the message, when the address is started at zero and counted up toward 255, the message will be sent in perfect code. To signal the end of the message, eight zeros are added to the end of the message. For example, the message "DEI" would be coded: 000111010100010001010000000. As the eighth zero has just been sent, the *nand* gate which samples all the outputs of the register will have all ones on its 8 input pins and the output of the gate will go to ground, pulsing the reset one-shot.

The basic sending cycle is therefore as follows. Assuming there is a message in the memory, and the address counter is reset, the start button is pushed. This puts a zero on one of the inputs of the start latch causing that gate to have an output of one. That one opens the clock signal gate allowing the clock signal to go through to the next date. The $\bar{Q}$ output of the one shot is normally high allowing the clock signal to go on to the counter and shift register. The counter begins to count from 0 to 255, sending the message in the process. The shift register keeps track of the last eight bits of message sent, and when the eight zeros signifying the end of the message appear, the *nand* gate fires the one-shot which both resets the counter to zero and closes the clock latch. The message is now ready to be sent again.

There are only four other parts of the complete unit; they are the programming circuit, the clock circuit, the transmitter interface, and the power supplies.

Of the four, the programming circuit is the most unusual. The particular memory device used, the 1101, has both a read/write input and a DATA input. The read/write, or R/W, input is normally low for the read cycle. When the R/W input is made positive, whatever signal is present at the DATA input is put into the memory location which is addressed at that time regardless of what was in that location before. During the write cycle two "bounceless" switches are used to

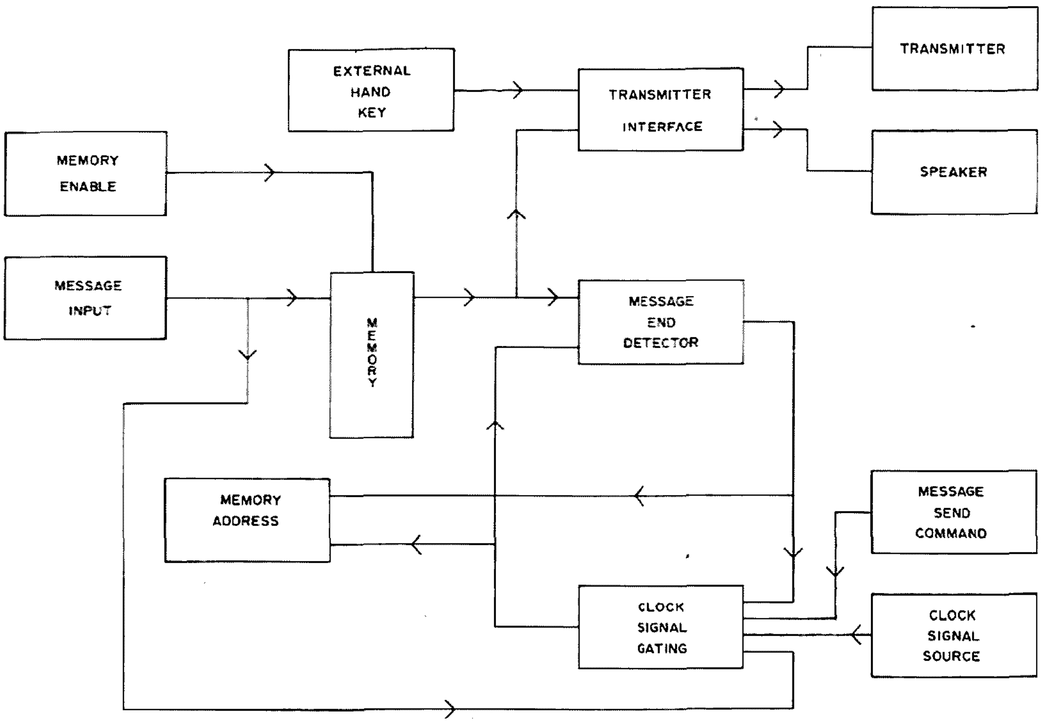


Fig. 1. The block diagram for the entire unit except power supplies. The signal paths are shown by the arrows.

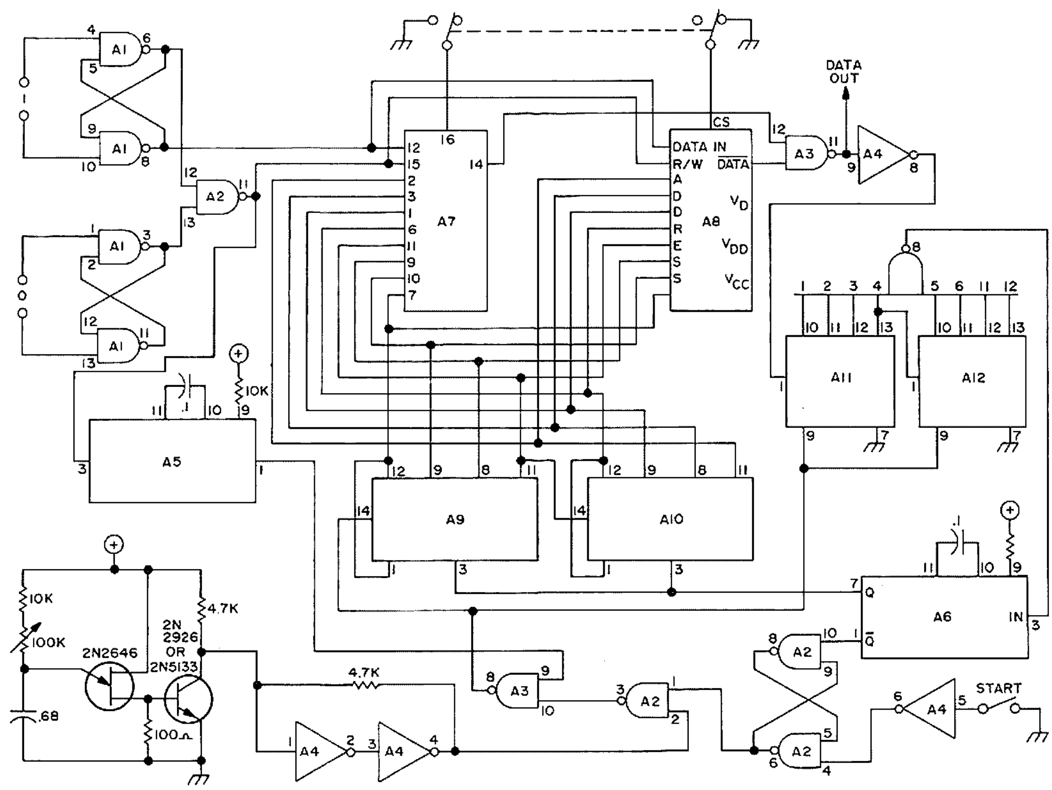


Fig. 2. The circuit diagram for the IC and clock portion of the unit. The numbers in parentheses refer to the 7400 series part numbers, and A, B, C, are three different type 7400 quad 2 input nand gates.

input the ones and zeros of the message. As each of these switches are pressed the R/W line goes positive, and the appropriate signal, either a 1 or a 0, is sent to the DATA input of the memory. As either of the input buttons is released, another one-shot pulses the clock line which advances the memory address one position so that it is ready to receive the next bit of message.

The clock circuit uses a unijunction transistor to provide a variable speed clock signal. With the resistor and capacitor combination shown, the Morse Memory will send Morse code at any speed from about 5 to 100 words per minute. A smaller capacitor could be used to increase the speed any more than this. The clock signal is further processed after the unijunction. Although the unijunction delivers a pulse with a very short fall time, the rise time was a bit too long to properly clock all of the devices. The transistor and two inverters are used to decrease these rise and fall times of the clock signal. The clock runs continuously and the output signal from the clock circuit is gated by the logic mentioned earlier. Since the speed of the clock signal can be varied over about a 20 to 1 range, a ten-turn potentiometer and counting dial was used to give better control of the speed.

The transmitter interface circuitry contains the devices necessary to both key the transmitter and to provide a sidetone output for the operator. There is a phone jack to allow a hand key or an electronic keyer to operate in parallel with the Morse Memory. The output of the memory and the key are cross-coupled so that either drives both the audio output and the reed relay which is used to key the transmitter. The tone of the sidetone is set by the two capacitors in the multivibrator; to increase the frequency of the tone simply decrease the size of the capacitors. The reed relay which is used is capable of following the output over the full range of speeds with no detectable error, however its power handling capability is rather low, so use it with grid block keyed rigs only. If your transmitter has cathode keying another larger relay could be keyed either from the reed relay or a larger driver transistor.

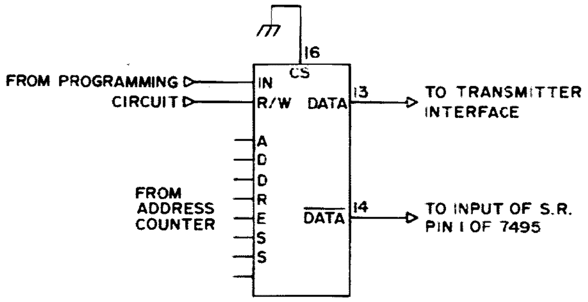


Fig. 3. These are the changes to the circuit diagram if one memory operation is desired.

The power supplies were constructed mostly from parts from the junkbox and are intended as a guide. Three different voltages are needed, +5.0 for all of the IC's and clock, 9.0 volts for the memories, and somewhere around +12 volts for the transmitter interface. The 5 volt supply should be capable of putting out close to 250 mA for an extended period of time which necessitates some type of heat sink on the regulating transistor. The −9 volt supply only has to handle 25 mA per memory chip so the power dissipation is reduced quite a bit. Try to make certain that the regulation is within ±5% and the ripple is less than .05 volts for both IC supplies.

Since it is fairly difficult to make a printed circuit board with the number of crossovers and with the extremely close spacing which is characteristic of large integrated circuit projects, the main parts ot the Morse Memory were constructed on Vectorboard with the .1 inch hole spacing which exactly matches the pin spacing of the 14 and 16 pin dual inline packages. To interconnect the pins #26 tinned solid copper wire was used. This wire is thin enough so that there is plenty of room to work with around the pins, but it is heavy enough so that it doesn't break easily and holds it shapé well.When the wires cross or come close to other pins the wires must be insulated. Plastic tubing which has an inside diameter slightly larger than the wire is perfect for this job, but some plastic tubing melts easily during soldering. Teflon tubing is ideal. To attach the wires to the pins form a small loop in the wire with needle nose pliers, slip the loop over the pin and tighten the loop with the pliers. Then solder the wire and the pin with a small soldering iron.

Integrated circuit sockets are useful but need not be used in excess. When the socket costs about the same as many of the cheaper IC's it seems silly to protect them with sockets. Each person can make his own decision about where to use the sockets; I used them only on the two memory units. Since the connections to the pins are made by wire, the IC's can be removed simply by taking the wires off pin by pin. On a printed circuit board the task would be much more difficult.

The entire project is housed in a surplus rack panel which seemed suited for the task

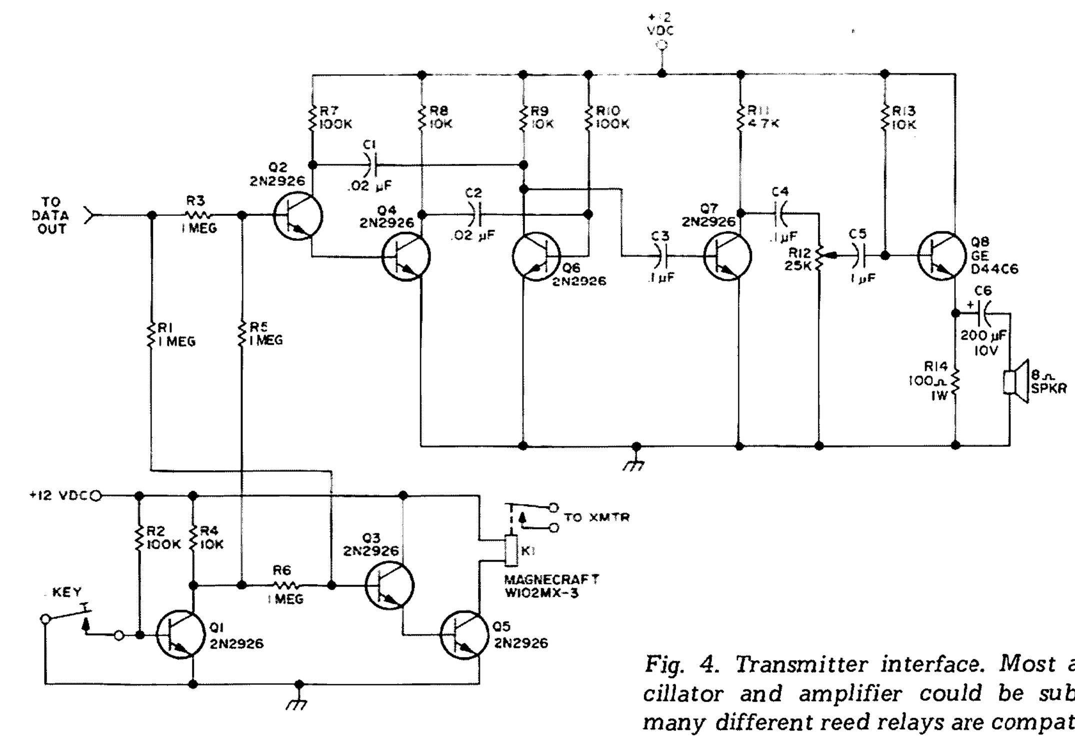


Fig. 4. Transmitter interface. Most any audio oscillator and amplifier could be substituted and many different reed relays are compatible.

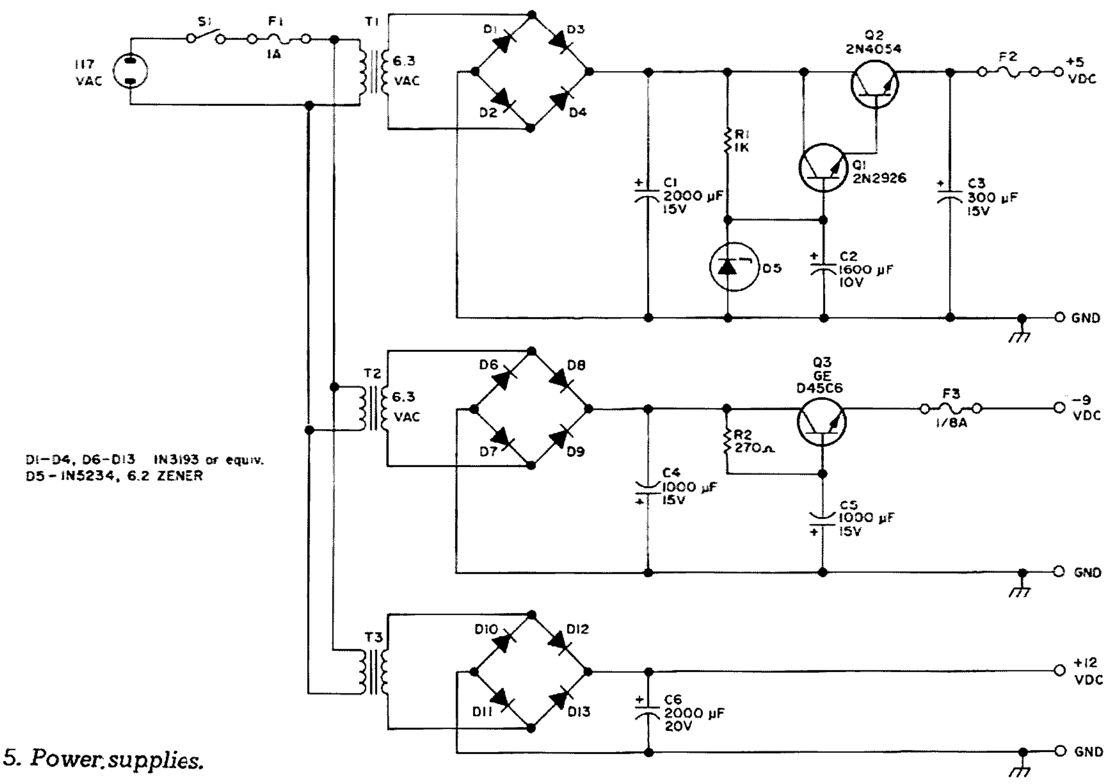


Fig. 5. Power supplies.

and was available on the day before field day. With all of the power supplies and controls the Morse Memory takes up a reasonable volume. With smaller transformers the weight and volume would be reduced by a large degree. I found no reason to label the controls; this job could, however, be done easily with the dry transfer type lettering. Make certain that the completed unit provides a reasonable shield against rf. This will prevent false keying by a nearby transmitter and will prevent false programming.

The operation of the Morse Memory will depend on the number of memory units used. With one 1101 most of the time some type of CQ message would be most useful. This will be somewhat shorter than the 10-minute CQ's heard often around the bands, but it can be repeated at a touch of a button. This message can be changed from CQ FD to CQ DX to TEST. With two memories full contest operation can be implemented. Of course an additional 1101 can be added at any time to increase the versatility of the unit. The wiring differences are minor between the two units. With one memory the chip select (CS) is tied to ground, DATA to the interface units, and $\overline{\text{DATA}}$ to the shift register. With two or more units all the address and input leads are connected in parallel. The CS leads are connected so that only one lead is grounded at a time and the rest are tied to plus. All of the $\overline{\text{DATA}}$ outputs are put to different inputs of a *nand* gate, the output of this gate goes to the transmitter interface, and this signal is inverted and fed to the shift register.

Once the unit is wired the first job is to check the power supply, clock, and interface. Be absolutely certain that the IC supplies don't go more than a few tenths of a volt above the ratings, and be absolutely sure that the polarities are correct to all units. It takes only a few milliseconds for the IC's to be destroyed with wrong polarity supplies. It is a good idea to test the IC board with commercially built power supplies with current limiting which might save a chip. After these dc tests, pressing the start button will normally produce some output signal even without programming a message. This is the state which the memory takes whenever the power is turned off and turned back on. To hold a message the power must be continuously applied to the memories. If there is no message start tracing the clock signal through, make sure that the counter is counting, and see if the shift register is working. Watch for leads which must be

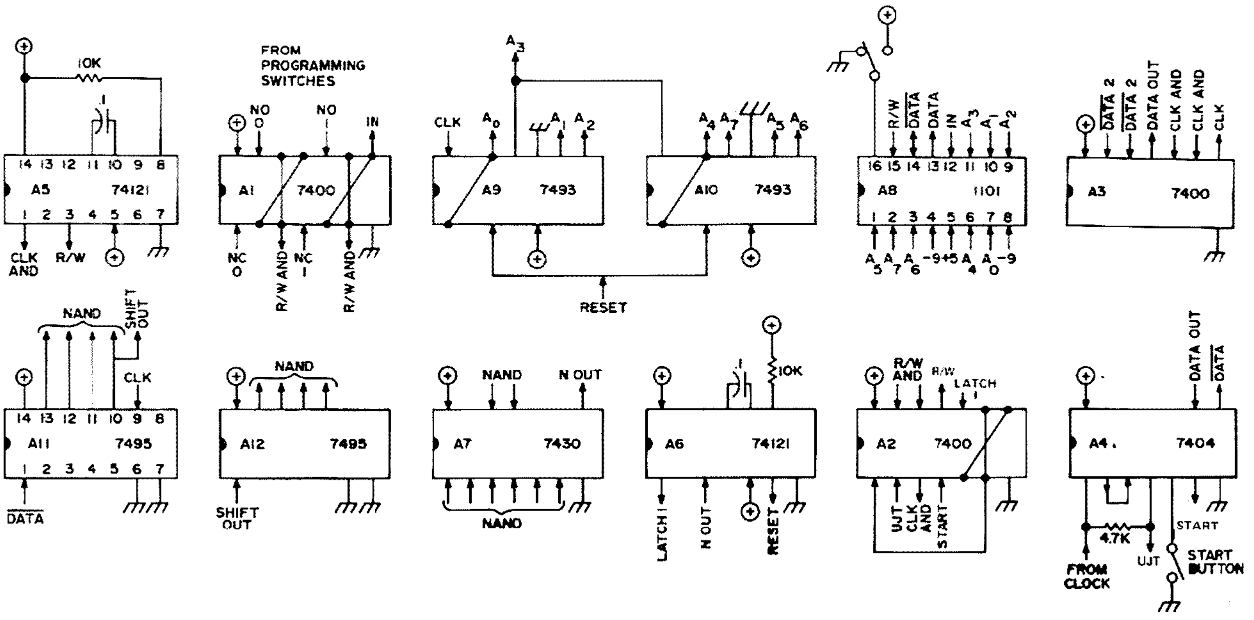


Fig. 6. The top view of the IC packages showing the interconnections of the pins. Wire the pins with the same names together.

normally grounded or tied to plus such as CS, counter reset, and R/W lines. The next job is to program a message and check the entire cycle. To put in a message code the Morse code into ones and zeros, and push the one and zero input buttons in the same sequence. To avoid confusion, turn the audio volume all the way down. Once the eight zeros are put in at the end of the message, turn the volume back up and push the start button. The code should be sent by the Morse Memory at a speed dependent upon the clock speed. With a little practice the programming will take very little time; it should take about two minutes to put in a 30 letter message in the memory. Once a message is put in one memory, if there is another memory chip in the unit switch the CS switch to the other memory and put another message in that chip. This will not affect the message in the first chip.

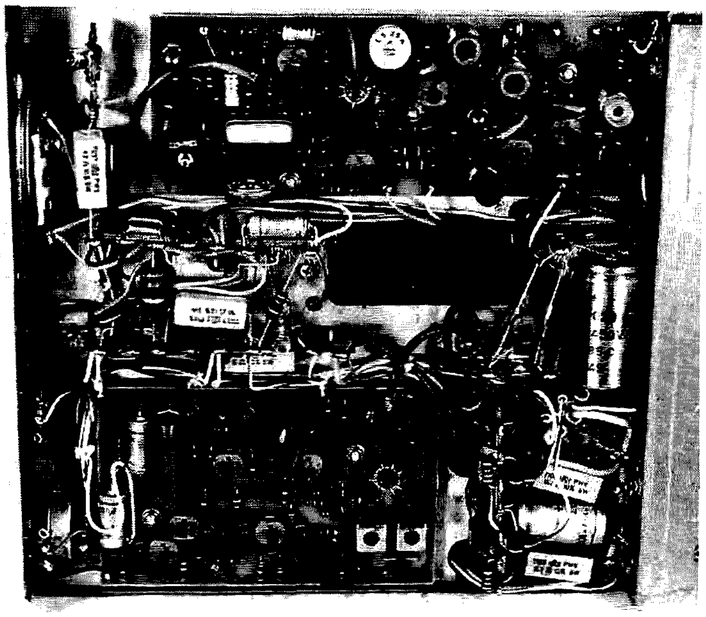
All of the TTL devices are readily available through any large supply house but prices can vary, so shop carefully. Be certain to specify the plastic dual inline package which is abbreviated as "N" or "P" after the device number. The Intel memory will be the hardest device to find although there should be no real problem. There was a recent price cut for the 1101 in a plastic package. The designation for it is the P1101A and the price is $20 in single unit quantities. This works out to something like two cents per transistor. The memories are available through Hamilton/Avent Electronics and Cramer Electronics. These two companies have offices in many of the larger cities in the U.S., but if there isn't a location in your area contact Hamilton Electro Sales, 10912 W. Washington Blvd., Culver City CA. There is a very complete data sheet for the 1101 which is very helpful in understanding the operation of the memory. This may be obtained from Intel Corp., 365 Middlefield Road, Mountain View CA 94040, or the local distributor in your area.

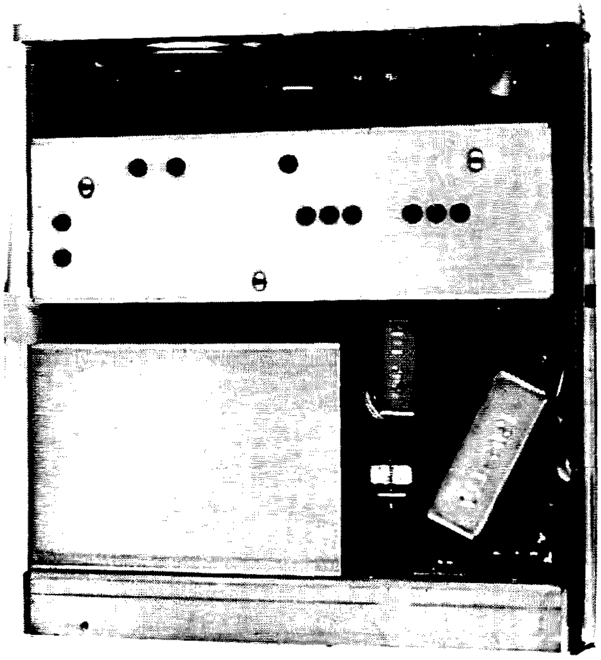
Aside from being a very versatile project and useful in many different areas, this project contains almost every type of integrated circuit device and will give a very thorough introduction to this rapidly expanding field. I would like to thank Dr. Carver Mead, Caltech, for his help on this project and the very thorough introduction to the field which he gave me.

...WA6ATT

Note: Devices and technical data are available from Circuit Specialists Co., Box 3047, Scottsdale AZ 85257. 1101A memory $20; 7493 – $1.90; 74121 – $1.80; 7495 – $2; 7400 – $.45; 7404 – $.45; 7430 – $.45; 2N2646 – $1.20; 2N5133 – $.30; 2N2926/HEP726 – $1; 2N4054/HEP244 – $1.75. Also available is 4" x 8½" vectorboard with holes on .1" centers and instant printed circuit subelements for mounting and soldering to the integrated circuits. The cost of the board and the instant PC subelements is $5.25. Please add a small amount for shipping.

73 Tests





the GLADDING 25 FM TRANSCEIVER

Though relatively new on the ham market, the Pearce-Simpson Gladding 25 transceiver is showing up on the air very rapidly.

The big difference between it and the other units is that "25" in the name, which means 25 watts output. Power has come to two meter FM. Surprisingly this power is available at a price that is remarkably competitive. The Gladding 25 sells for $249.95 in the 12-volt model and for $299.95 with a matching ac power supply.

The two meter model is almost identical with the famous Gladding marine transceivers, which are about the best selling in the world. This volume of business undoubtedly helps them to keep their price a lot lower than it might be if they were making units for amateur radio alone.

Those of you who have read the ads for solid state amplifiers recognize why most FM transmitters are limited to around ten watts. Transistors are available for up to 100 watts or more, but the price is a bit out of the average amateur pocketbook range, running up to over $200! Gladding pulled a fast one with their rig by using tubes in the driver and final. Tubes may be old fashioned in some circuits, but for power amplification they are still the least expensive route.

The Gladding, like the Drake, Tempo, Telecomm, Sonar and Swan units, uses 12 MHz crystals for the transmitter. The receiver uses 78 MHz crystals, which is a departure . . . this being the only amateur FM rig we know that uses these. The transmitter crystals have air padding capacitors for zeroing in the channel. There are six separate channels.

The transmitter has a power level switch

which helps conserve your car battery when the 25 watts isn't really needed. The output is one watt in the low power position. There is a "monitor" position on the power switch which turns off the amplifier filaments and thus conserves bąttery power, if this is important.

The Gladding is surprisingly well made, particularly when you consider that price. The circuits are on boards, IC's are used, and there is a lot more shielding than you will see in most other rigs. The crystal compartment has its own shield, as does the receiver rf and i-f section and the final amplifier. The final is shielded both below and above the chassis!

The receiver is considerably better than some we've tested, probably due to the eight pole crystal filter in the 10.7 MHz i-f. We have an enormously loud repeater about 70 miles from here which runs about 15 hours a day average on 146.91. Many receivers are just about useless when this is on if we want to listen on 88 or 94, both among the most used channels in our area. If you have 60 kHz spacing to your nearest repeaters you probably won't have interference and a sharp i-f won't make that much difference, but if you've got a signal of substance just 30 kHz off channel, this may be an important factor to keep in mind. The advertised selectivity of the unit is 60 dB down at 15 kHz.

The receiver and transmitter crystals switch independently, so you can use the 34/94 pair or, if you happen to live in a run-down part of town where an old repeater is still grinding out 34/76, you are still set. By adding a 16 transmit crystal you will be on 16/76 for modernized repeaters. If you are uptight about your 34/76 repeater please try and ignore the sarcasm . . . but do let the idea of shifting to 16/76 perk somewhere in the back of your mind, even if it is way, way back.

All in all, we liked the Gladding 25 and think it is a remarkable buy. . . . Staff

Tell Our Advertisers
You Saw It In 73
(Even if you didn't)

73 tests the GAM TG-5-S Gain Vertical

Perhaps "tests" is a bit extravagant. To be honest about it we didn't run tests with the antenna, we just decided to use it and thought you might be interested in the rationale behind the choice.

The repeater here in Peterborough is on top of Pack Monadnock Mountain. To be precise, the receiver is on top of the mountain and the transmitter is down about 300 feet or so about one half mile away. There are two reasons for separating the transmitter and receiver. One is to prevent desensitizing the receiver every time the transmitter comes on the air, which can be a serious problem when the two are side by side, and the other was to get that little extra gain the very top of the mountain obviously provides.

The tower beside the transmitter shack is 100 feet high. We put the antenna on top of the tower . . . probably because antennas are always supposed to be on top of towers, not at their base. But this brought on the obvious problem of some of the rf getting lost on the way up to the antenna. Though we used RG8/U foam cable for the job, the spec sheets still let us know that we can expect to lose about 2.5 dB over that length. Figuring a few more feet into the rig from the tower we manage to lose 3 dB over the path. That's one half of the power! Zounds!

The logical solution to that is to run more power. This is logical and expensive. If you figure it out at all, you will see that the most economical way to amplify your signal, within reason, is by putting up a gain antenna.

The specs on the Gam TG-5-S antenna tell us that it has a 10.5 dB gain over a coaxial antenna. That certainly would more than make up for the 3 dB feedline loss and might even make up a good deal of the difference between the transmitter and receiver heights. A repeater is working its best when it can be heard as well as it can hear. If it covers more area with its transmitter the mobiles can hear it clearly and not get into it, a most frustrating experience. If the receiver is better than the transmitter, then fellows go through the repeater who can't get the transmitter, a frustration to everyone who can hear the rig.

The first tests of the system, using a ground plane antenna on the receiver and the Gam TG-5-S on the transmitter, indicate that the coverage of both the transmitter and the receiver are fairly equal. Mobiles in Rhode Island have been able to work through the repeater to work mobiles in Maine, both over 100 miles away from the mountain.

The high gain of the antenna is achieved by placing and phasing the radiating elements one over the other. This squeezes the radiation pattern down toward the horizontal, giving the gain. Radiation at a high angle is wasted unless you want to do a good job on passing planes. . . .Staff

SCR Mobile Theft Alarm

Dominic Bottaro
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There is a very simple and inexpensive circuit ideally suited for the protection of ham gear, tape decks, and other car accessories.

The circuit, as shown, utilizes the car horn as an alarm, but it can likewise be used to energize a siren or other appropriate equipment.

The circuit components consist of a switch, one resistor, and a 90¢ SCR.

The circuit (Fig. 1) gets connected to the horn button side of the horn relay. Wire A, originating from the gate of the SCR, is connected to the grounded case of the equipment to be protected. This prevents triggering of the SCR until the time that this wire is cut or disconnected. A thief, determined to steal a piece of equipment (ham gear, tape deck, radio, or outboard motor on a boat), by necessity must disconnect all wires leading to the equipment; in so doing he would unground wire A, allowing gate current to flow and trigger the SCR, which in turn would energize the horn relay (and, therefore, the horn or siren).

To protect several pieces of equipment, the circuit must be duplicated as many times as needed with the exception of the switch.

Figure 2 shows how to protect several accessories or pieces of equipment.

. . .W1BHD■

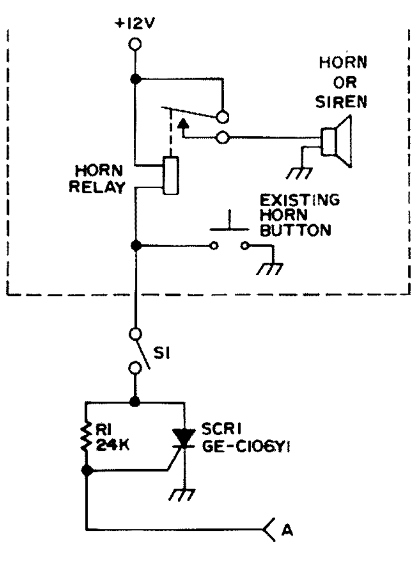

Fig. 1. Mobile theft alarm circuit.

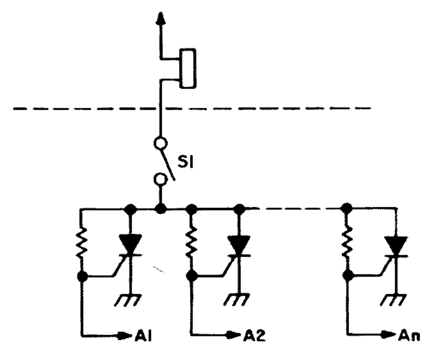

Fig. 2. Paralleling SCR circuits will protect several pieces of equipment, even though only one "safety" switch is needed.

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England

DX QSO's or CONTACTS

A recent Leaky Lines discussed the broader aspects of DX, and deplored that DX contacts were always so brief. Here we have the nub of the point.

DX is *not* synonymous with contests. It can be the opposite. A contest, as the name implies, is solely competitive and no attempt is made to get to know anything about one's opposite number, nor is there time to do any comparative tests of a technical nature. A DX QSO need not resemble a contest contact. In fact, it can be a QSO either devoted to learning about the other fellow, or trying out some technical test or other.

I have been on several minor DXpeditions such as ZD3F, G3BID/6W8, 9H1BN, and G3BID/CN down to more mundane calls such as G3BID/LX and others; and have studiously avoided making nothing but contest contacts. Occasionally for perhaps half an hour or an hour I have worked contest style, but never for long periods. One of my short bursts of contest operations was in Southern Morocco when near Zagora. I had driven up a hill called the Djebel Zagora. I found 10 meters open to the States and worked one hour of contest contacts to give a lot of Ws a mobile contact from Morocco. But that was enough.

Next morning I heard a VK2 on 40 meters, but failed to contact him because he was working a W7 and, therefore, listening outside our band. So, changing bands, I worked another VK2 on 20 meters and got him to inform the 40-meter VK2 to look for me next day at the same time on 40 on his own frequency.

This resulted in a QSO (not a contest). Having established communication on 40 meters with the VK2 from the car, I asked him to listen carefully while I rotated the car through 360 degrees, and note my report. He just copied me for about 45 degrees either side of the peak signals and then lost me completely for the other 270 degrees. This gave a clear indication of the directional properties of the car. But there were two Gs also on frequency, and they reported little or no change as I rotated the car.

So we began to establish the difference between the directional properties of the car for low angle radiation, about 12,000 miles (long path) and for high angle radiation, about 1,500 miles. That is a DX QSO in my opinion.

In ZD3 and 6W8 I made a point of only working contest style contacts for a maximum of an hour at a time, but normally I had QSOs describing the scenery, the climate, the people I had met, as well as getting to know the people at the other end.

Because I have never worked in a contest even from the home station, and have always had QSOs, not contacts, I was able to meet many old friends on the air – amateurs I had worked frequently from England and elsewhere.

These personal QSOs even resulted in my being able to get a transceiver supplied by some very kind American friends to one of my friends in the Gambia and get a local radio club started under the auspices of the Prime Minister as first Patron. This club is

now flourishing and took part in the Boy Scouts Jamboree in the air.

This is, I imagine, the different aspect of DX which you are seeking.

One of K2AGZ's articles refers to "Ugly Americanism" and looks forward to changing the opinions of foreign amateurs with respect to the overstressed image. May I as a Briton (not Britisher please) offer a suggestion or two?

May I make a plea for greater sincerity? Some amateurs put on a false and totally unconvincing friendliness, when clearly they are not genuinely interested. I have received printed QSL cards expressing great pleasure at this "personal" contact with friends overseas and thereby "helping to establish world friendship." If all this talk of "personal" contact and "friends" is printed, it smacks of insincerity. Few Europeans are likely to believe there is anything either personal or friendly if the whole thing is printed.

Of course, I use printed QSL cards. My call is printed. The type of rig is printed. The type of antenna is printed. The type of receiver is printed. The mode of QSO, CW, AM or SSB is printed and the address is printed. These are not personal. These are the same for everyone and make no pretence of being personal. But to print one's appreciation of a "personal" contact and "friendship" is degrading the words themselves, like the word "personalized" which often means "produced by the thousand," and exposes the insincerity of the amateur who sends them.

Obviously no human being likes all the people he meets – he would not be human if he did. Likewise, no radio amateur is going to enjoy a QSO with every amateur he meets on the air. One must be peculiarly insensitive if one cannot feel within a few minutes whether the QSO is going to be enjoyable or not. If one is obviously talking with someone with whom one has clearly nothing in common, with someone with whom the conversation will be dull and uncongenial, one can always sign quite politely and move off, but one need not then indulge in fulsome phrases which are obviously insincere, such as, "Look forward to meeting you further down the log" when it is quite clear that the personalities do not fit and there will be no pleasure in having another QSO; nor in saying, "Whenever you hear me on, please give me a shout," when it is clear that one hopes never to repeat the dull QSO which one is gladly about to end.

Real international friendship is not established by stereotyped insincere phrases. Apparently many amateurs do not realize that the insincerity comes across quite clearly, except under conditions of the very worst QRM.

It is, of course, easier to conceal the insincerity on CW where the tone of voice doesn't come across quite so clearly. But even here I wonder if the fist doesn't indicate whether the other fellow is enjoying the QSO or is only anxious to end it.

But, above all, the QSL which has printed remarks about "personal" QSO, "enjoyable" contact, or "friendship" are so palpably insincere as to spoil any illusion of there ever having been a "personal" or "friendly" contact.

. . .G3BID

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CODE SHORTHAND

After one has learned the twenty-six letters of the alphabet, the ten numerals, and approximately ten punctuation marks, and progressed to about ten words per minute in code speed, he generally finds himself on a "plateau." Progress to greater code speeds seems for a time to come to a halt.

Progressive learning of any art (and code *is* an art), according to psychological research, takes place in "steps." But there are actually ways of advancing many steps at a time. This article is devoted to one of the many methods which can be used to skip a few steps and hasten the process of acquiring superior code speed in a shorter time.

It is comparable to the shorthand used by stenographers for years to write a language in the form of symbols. One of the principal ingredients of any shorthand is the use of "word signs." Practically all of the *short*, frequently used *words* in any language are represented by simple "word-signs," which are actually simple, very short strokes used to represent a word rather than use a multitude of strokes to represent the characters forming that word.

If one wishes to accrue superior code-copying ability, he will have to learn to read and copy words and short phrases just as readily as he copies single letters. In short, he learns word forms instead of single letter forms.

Actually, one of the first word forms to learn is "the" because it is used most often in the English language. It is no more difficult to copy – ···· · than it is to copy the character 9 (––––·); and really, in terms of time-space, the two are about equal. The word "the" takes up 17 time elements, and the character 9 takes up 17 time elements, if one cares to count them up. It takes the same length of time to transmit the word "the" as it does to transmit "9."

In code, as in a lot of other arts, there is nothing quite like practice to make one proficient. Except, as herein noted, the time is spent in word-copy instead of letter-copy.

To facilitate the use of this system, a list of the short repetitive words used in the English language is given here for the student to practice. If you have a small, inexpensive tape recorder, it will pay to record these (each one at least five times) and then copy them back many, many times; and a good trick is to record them at the slow speed, then play the tape back for copy at double speed.

Two-letter words are more easily learned first:

OF TO OR ON AN HE NO DO
WE IN IT IS AM

Then, progress to three-letter words:

BUT THE AND WAS WILL SHE
HAS HAD NOT WHO FOR ANY

This will make progression to the four-letter words, as given below much easier, as a lot of the four-letter words are mere continuations of the two and three letter words:

WERE WILL THEY THAT HAVE
THEM WITH HERE FROM MORE THAN

The student can add many of these two-, three- and four-letter words to this list to record and copy at double speed.

Phrase Copying

The next step in speed-copying is to progress from simple words to phrases. In shorthand, phrases consist of combinations of word signs strung together.

Some of the simple, repetitive phrases found in common usage are listed herein as a guide to those that should be recorded and copied:

IT WAS	OF THIS	WITH THE
I AM	WILL HAVE	THEY ARE
THAT IS	FOR THE	IT WAS
TO THEIR	AND THEY	WE WILL
FROM THE	IT IS	OF A
IN THE	SHE WAS	DO NOT
WE ARE	IN AN	TO THE
HE IS	OF THEM	AND HE
HE WAS	WILL BE	THEY WERE
THAT WAS	ON THE	SHE IS
AND THE	TO THEM	THEY WILL

It will take from three weeks to a month with copy at the rate of at least one hour per day for the student to become proficient at copying these two-, three-, four-letter words and phrases.

But one will notice that automatically his code speed is increasing in direct proportion to his facility in copying. If one wishes more of these phrases, he can consult a "shorthand" book which will list practically all the phrases in common usage.

Prefixes and Suffixes

There is one more device which can increase the student's code speed immeasurably. This is to become proficient in copying prefixes and suffixes.

There is no greater truism than that in code copying the long words become the stickers. After copying the first few letters of a long word, the mind seems to go into reverse, and a letter or two in the middle is lost—and one might as well forget the rest of the word, because in attempting to copy the lost letter or letters, the complete word is lost. This is a common state of mental confusion (or mind block) and anyone who copies code knows about it.

By thoroughly learning the prefixes and suffixes, and shortening the "automatic response" time when they are encountered, the student gains copy time going into the middle of a long word, and then he has a better chance of copying the central letters; and by thoroughly automatizing the suffixes, if the copier falls a letter behind, and the suffix phrase is recognized, the student will automatically be able to quickly complete the word correctly.

Here is a list of some of the common prefixes used in the English language (these will vary somewhat with other languages):

ILL	MOT	SUB	EX	MOT
SEM	FER	WHE	CAR	PRE
UN	CON	MET	INF	ADD
ED	MEN	PER	AD	BRO
ALL	FOL	COM	TEN	INT
CO	POS	ANO	FOR	REL
DIR	ANTI	COL	EVE	TEM
REP	BOR	WE	BAR	PRO

Following is a list of common suffixes (word endings):

TION	ILY	AIN	ERT
ONE	LY	DENT	CED
MINE	ALE	CAL	ASE
ALT	DAY	SED	DER
EST	ANE	ITE	ANY
TON	ICT	ULD	ERY
ALY	CED	AIL	DED
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It must be emphasized that the more common prefixes and suffixes, such as pro, ed, in, and, tion, ing, must be so thoroughly imbued in automatic reaction that there is absolutely no hesitation in recognizing them, and copying them as such.

Prefix and Suffix Combinations

The reader should immediately recognize the fact that certain combinations of prefixes and suffixes actually form complete words—such as words like "promote," which consists of the prefix "pro" and the suffix "mote."

In longer words, such as the word "admission," here we have two suffixes following a prefix: "ad", the prefix and "miss," one suffix, followed by "ion," another suffix.

It should readily become apparent that once one becomes proficient in this type of code shorthand he will notice an immediate increase in his code-copying ability and his speed will jump from five to ten words per minute over any previous speed in a very, very short time. By the use of a trick system, the student has jumped a couple of steps, instead of struggling to take them one by one.

. . .K2EE■

Ralph W. Campbell W4KAE
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Lexington KY

VHF Double Sideband

Here is the simplest way of generating "almost SSB" on VHF. Avoiding the usual problems in generating SSB, this circuit shows how to build a Double Sideband Suppressed Carrier rig for 2 Meters. Why not start working real 2 Meter DX on groundwave!

Several years ago an article appeared in one of the amateur journals using tube types similar to those presented here, for DSBSC operation. I duplicated that design, but with disastrous results! It simply wouldn't work right. Five or six months went into constructing the unit, all to no avail – until I tried using slightly different pentodes in the balanced modulator configuration, based upon intelligent use of self-bias and adherence to the tube data.

Now, with piles of nonworking drilled chassis, partially destroyed 8156s and a half-melted 7984, I feel I am the authority for workable DSB. I worked Canada from Kentucky, with 2 meters "closed" and no aurora prevalent. If there's anything "wrong" with double-sideband, disregarding the confusion with AM radiotelephony, it is the operator's inability to tell which sideband he should tune. Operator error, plain and simple.

My ultimate goal is to provide fellow amateurs with a simple, reliable SSBSC generator using the phasing method as developed through my DSB efforts. DSBSC is practical, simple, and the best way to get your feet wet on sideband. All of your friends become only "appliance operators" you might say, if it is pointed out that heterodyning a commercial rig is not the same as building a sideband *generating* unit where results depend upon the homebrewer. With the equipment shown here, the next step is "single-double sideband," to coin a catchy term.

This article is entitled *VHF Double*

Sideband because it tells how pentodes can be successfully used above 50 MHz, dispelling the popular fable about high input capacity and circuit balance limiting use of higher powered balanced modulators above 6 meters. Our balanced modulator nulls the carrier by phasing and tunes out input reactance with an inductive divider. Differential capacitors are seen as being useful on 432 MHz and up, where strays force the designer to use "inductive" plate circuit symmetry.

Operating Class

"Class of operation" has been ignored by most authors when describing balanced modulators. Or maybe a quick appraisal as "pulse" has been thought adequate. I got a bit further. With the first high-level unit being made from 8156s I discovered some interesting things. First, plate voltage must be no higher than for normal class C operation. Second, fixed bias must not be used; resistor bias is adequate because there is no dc screen voltage present. And third, a swamped screen circuit is preferred for stability and development of audio voltage for generation of plate current pulses.

There was no need to place any dc voltage on the screen's centertap at any time. Plate voltage of about half of design maximum rating is plenty adequate with high perveance tubes, or consult the classified data for typical operation. If you should double the plate voltage, even within the design-maximum region, you'll find the distortion so high no one will know *what* you're running.

Getting back to our composite operating class – the grid circuit in my balanced modulator runs class C. You might say the audio-driven screens are running class B, since they're swamped but have some dc component on peaks, even though grounded like zero-biasing. The plate circuit is operating with large current pulses, however, so I guess we can call that portion "pulsed." So, the aggregate of these considerations might well be dubbed "class B, pulsed," as typical operation.

Plate Tank Circuit

Don't use excessively high-Q tanks on

VHF. A convenient way of avoiding this problem is by restricting your experimenting to a particular brand of split-stator "butterfly" capacitors, like the E. F. Johnson 160-series. The largest one they make in this M series is for 2 meters: The 160-211 is my choice.

Using ferrite or dust cores is not always recommended. Permacor X-7451 type IRN-9 material should find best application on 6 meters; but on 2 it is too lossy. IGC Ferramic Q3 material might find decent use above 100 MHz.

Another word on practical theory: Make sure an rf bypass is used for plate current pulses. It is not satisfactory to omit the bypass after an rf choke is used on a capacitive-split tank. The reason is that plate current rf pulses, at an audio rate, must be returned to ground. This speech-frequency pulsed energy can be strong enough to destroy a low-reactance button! Power supply filtering will help, but the lead reactance to the electrolytics can be so high as to result in lower DSB output and instability. In the next design I try I'm planning to use an *output* audio choke along with the electrolytics and silver mica 0.001s.

Turns Ratio

Turns ratio is interrelated with tank circuit considerations given earlier. However, the concept of matching a plate load impedance under pulsed conditions was attempted. We did this by using a reflectometer and driving the output tank backwards from the coupling loop. I was limited in achieving a perfect match by the output capacity of the tube and the LC ratio obtained. That is, the butterfly's capacity set this ratio and happily this seemed good for audio fidelity and not necessarily the greatest output. Presumably this is the sort of tradeoff that must always be made in an optimized design.

One and one-half turns for the coupling loop and at least 3.5 times this is okay for the total number of tank coil turns, depending upon size of coil wound. Tighter than usual coupling is sometimes desirable on VHF in cases where plate resonant load impedance is low. It should be remembered that plate power pulses are on a 4:1 duty

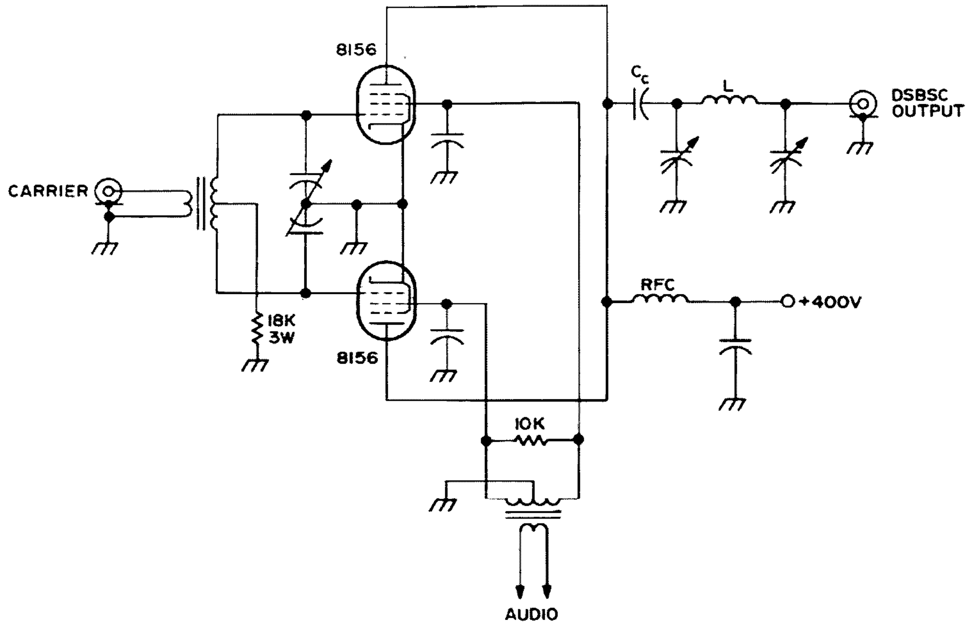


Fig. 1. Conventional method of generating DSB suppressed carrier.

factor with DSBSC (rather than 2:1, as with SSB).

Practical DSB Schemes

All DSBSC generators that do not result in high power losses utilize balanced modulators in one form or another. On VHF, with a commercially made exciter, the best way to go sideband is by using a high-level BM rather than a low-level one. The reasons are obvious: The TX-62 exciter in use at W4KAE already puts out 10–15W on 2m. And I drive much higher-power linears, which need additional watts PEP to push them to 500W average power output. Insertion amplifiers cannot be tolerated because of difficulty of obtaining adequate stability with very high peak powers. The several working circuits I recommend, for stable operation follow:

Figure 1 shows the more conventional method of obtaining DSBSC on the HF bands. Usually, it is not necessary to add a differential capacitor, since the DSB gener-

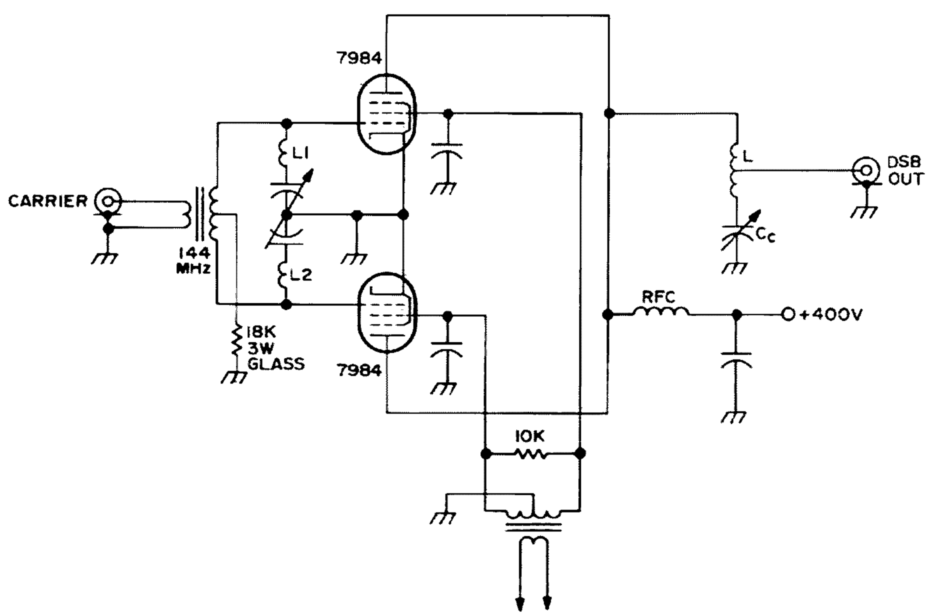


Fig. 2. W4KAE's original "divider input."

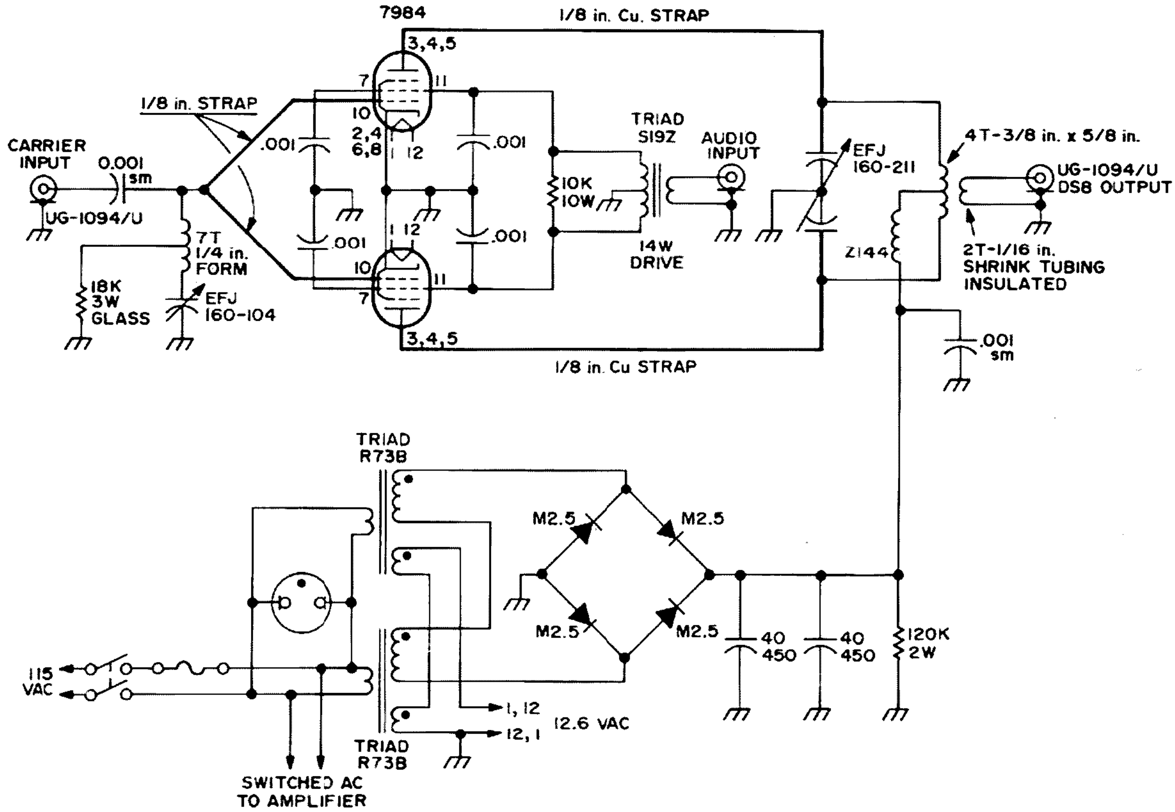


Fig. 3. Final 2m double sideband suppressed carrier transmitter and power supply.

ated results from 90° phasing either side of centertap. Quadrature phasing is simply half of 180° "push-pull."

Figure 2 shows a special push-pull "divider input," my own original design. This circuit is especially useful when very high capacities are encountered on UHF input circuits. The input transformer secondary is to be self-resonant with tubes in place and associated strays. Grid-dipping must be done before placing L1 and L2 in circuit. Once the broad-resonance condition exists, the two inductors should be peaked with the input butterfly so that *balanced series tuning* with both tubes' input circuits is obtained.

Figure 3 is a most successful medium-powered DSB ham rig. Featured is a high current supply made from two Triad 200 mA low-voltage power transformers whose windings conveniently series to provide 400–450V. A total of 80 μF is needed for filtering to get a T9 note on the nulled carrier. Carrier suppression is −36 dB, even so!

An inductive divider is used on input. The 10 kΩ, 10W wirewound resistor is a swamper which provides increased stability when audio gain is opened up about ¾ turn. It also provides an impedance match to the hi–fi amplifier used in BM service.

Alignment and Adjustment

To tune the balanced modulator, all you need is about 5W of rf drive (from HW-17 or TX-62) and an swr bridge. The bridge is used as an output indicator. First peak the grid circuit for a small meter deflection, with sensitivity control at maximum and key down. The BM should be plugged-in and turned on, of course. Notice that the peak can be increased greatly by output tank adjustment – if it cannot, disassemble the unit and check to see if tank variables are within stator mesh. Grid-dipping can help greatly here, before firing up.

When both input and output peaks are obtained (with no audio feed), the swr bridge sensitivity can be turned back to about 10% full-scale and some audio can be

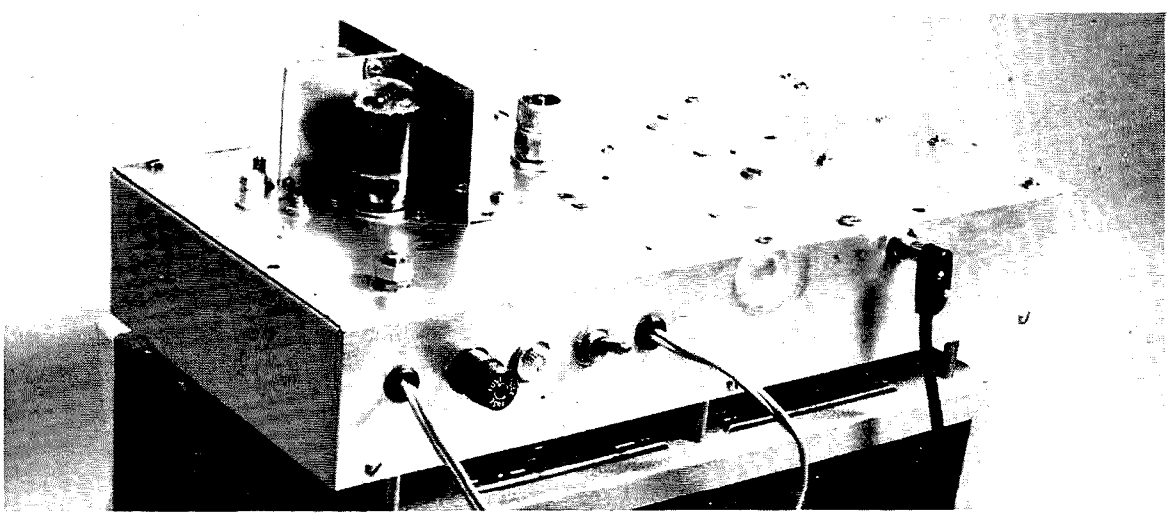
injected to the screens. Speaking into the mike should cause momentary full-scale readings. Driver must operate key down, as before. There is a point where increased audio gain will result in increased distortion (I listen on headphones while my receiver is partially muted). With a *dummy load* connected and vswr normal, the point can be determined visually by observing the erratic output meter indication. Eliminate residual shack noise by shorting mike input when setting audio level.

An oscilloscope can also be used to gage flat-topping; however, inexpert use of this instrument can result in disaster quicker than by reliancee upon elementary auditory monitoring with headphones and the bridge. An itemized procedure without the scope follows:

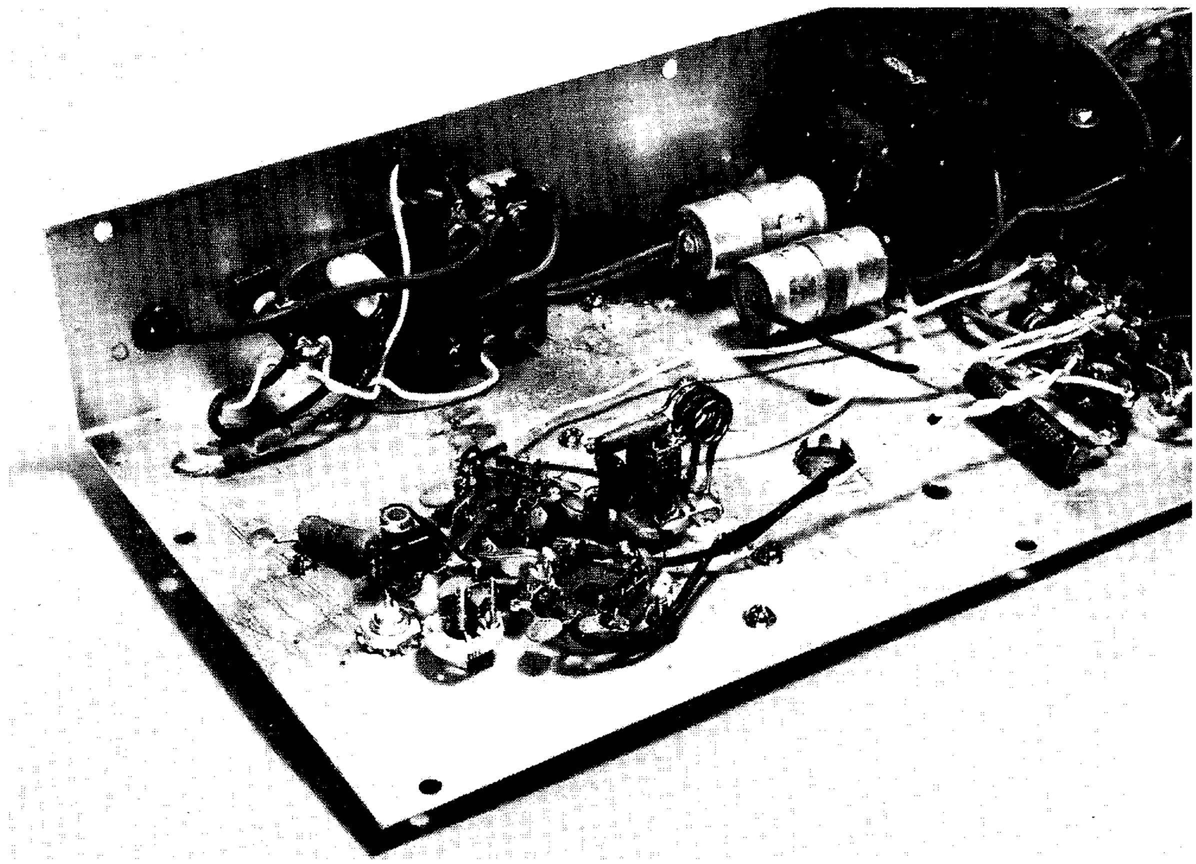
1. After peaking the circuits as above, keep feedthrough indication no higher than about 10% highest momentary level (without speech, key down). 2. There should be no variation in feedthrough level with the microphone switched off. 3. Juggle the drive level so that enough excitation is present to allow maximum deflection on the output indicator, but not so *little* as to *not* allow whatever loud vowel sounds may be spoken to register full-scale momentary indication. Note: This rf driving range is quite broad, i.e., from 1 to 5W (estimated) on the paralleled grids because resistor bias is self-regulating. 4. Repeat these steps until you're sure there's no instability, exciter (driver final) heating, or rf feedback.

Actual carrier suppression is much greater than merely 10 to 1! The difference between the indication of so-called "average" signal and nulled carrier is about 100 times. For example, most of the feedthrough is simply drive power or capacitively coupled in-phase energy that is rejected from balanced modulator output during those intervals when speech is present. Remember, in-phase energy like this is normally rejected by any voltage amplifier when used in power circuits, by normal 180° phasing. An exception would be the cathode follower current amplifier, or the grounded-grid power amplifier.

To finish adjustments I found it convenient to listen again on my receiver to the DSBSC signal, with upper sideband setting preferred. I do this with the rf gain all the way back. That sing-songy sideband sound is reassuring. Careful adjustment of tuning results in good-quality sideband. An oscilloscope might find use, now, as a final check. Calling a friend to check out your gear is an excellent way also. Experience will show you need *not* try for momentary-peak indications on a monitor to be



This photograph shows the completed DSB unit and its mounting upon the Heathkit AA-13 monophonic amplifier. The three-leaved inter-partition shield is necessary to prevent oscillation and resultant instability. Two types 8156s are depicted, although the final "4th generation" version uses 7984s. A screwdriver adjust pot is provided; however, this was abandoned when we went to self-bias as opposed to fixed.



Here's the final version (underside) of W4KAE's DSBSC rig. Note the inductive divider series tuned input made from an E.F.J. "M" capacitor and a ceramic form series coil, connected with 1/8th in. strap. The silver mica 0.001 capacitor connects to the "Y" going to both control grids in parallel. Output tank has moderate L to C ratio, using a 160-211 butterfly variable which establishes rf ground.

the same as full carrier indication at the same power level: this is because the meter damping will not allow true "peak" readings. Because of this, don't "talk up" to the same level you used to run on AM.

Use and Conclusion

Using the 2m VHF double-sideband rig is fun. Most SSB stations in Cincinnati could not tell the difference between it and their mode. DX stations like VE3BIG could copy very well; however, the only problems (with DX) came when a multipath fadeout forced retuning on their part, and confusion resulted in which sideband to use. This is not as great a problem as might be expected, however, because we use the piggy-back method of DXing and everyone stays right on frequency (no tail-ending)!

Concern about wasted power in the other sideband is almost academic in practical operation, since duty cycle is quite low for SSB or DSBSC. If "they" can hear you at all, chances are the lost energy is unimportant. If your linear can be run at slightly lower plate voltage than normal, you can get some increase in signal by overdriving it a little – getting rf clipping this way – but don't crank the audio up into the balanced modulator.

The one disadvantage to DSB is the operator confusion previously mentioned: It's not so bad on DX, but 80-mile Cincinnati stations tend to become relaxed in a long QSO and sometimes they forget which sideband to tune, winding up with a 3 kHz offset on alternate transmissions! I'm sure this problem can be overcome if operators learn to switch sidebands on their recivers, when hearing backward speech, instead of trying to retune for just one sideband. With DSB, you should always switch from UPPER to LOWER or vice versa, when hearing "backward" speech – then retune.

. . .W4KAE■

73 tests the 270 AUTOMATIC ALARM

And likes it . . . and likes it!

After having a nice brand new Standard FM transceiver ripped out of an assistant editor's car, and further to find that this multi-centibuck investment brought nothing from the assorted insurance companies (which are gradually bleeding us of as much green corpuscles as they can) but shrugged shoulders and polite letters of too bad but we don't feel that we covered you for this, nervousness set in every time I looked at the mass of two meter FM gear that had accumulated in my car.

Never one to go at anything in ham radio half way, I set about being able to get into all of the repeaters in W1- and W2-land from my car. This built up into three rigs and three antennas around the top and back of the car, making it look like a wounded porcupine scuttling down the road. I was able to hide two of the rigs in the large Rover glove compartment, thus keeping them out of sight when not in use, but this still left a third sitting up on the dashboard as a tempting prize for any enterprising youth. This isn't much of a problem in New Hampshire, of course, but then I do drive down to New York and other areas where the life of an exposed piece of gear is measured in minutes, and it is a drag to have to put the rigs in the trunk every time I park.

Being an avid reader of 73 magazine, I could hardly help but notice that ad in the November issue by Technical Product Development Company for an automatic alarm. I went the whole way and ordered one of their Model 270 Automatic alarms, complete with siren. The alarm gadget costs $50, if you get it with all the options. This includes a recycler which turns off the siren after about two minutes and resets again automatically to guard against re-entry. The alarm is $40 without this feature. A manual model is available for $30 with the recycler and $20

without. The siren is $19 if you prefer that to using your regular car horn. There is something particularly alarming about a siren, so I went that route. I figured there would be no question if I heard my car sounding off in a distance that way.

So there was old fumble-fingers Wayne, armed with the alarm system, a set of instructions, and a pair of wire cutters. The whole operation took me just under two hours, and that included a couple of pauses for coffee, a long phone call from an author, and some hunting around the house for solder lugs and screws that I turned out not to really need. I think one hour would have done it if I could have kept my mind on what I was doing.

When the job was done there came the good old "smoke" test. I sat in the car, turned off the ignition, waited one minute and then opened the car door. Would it work? Ten seconds later the siren let loose and the whole east end of Peterborough knew that it worked.

You have about 40 seconds or so after you turn off the ignition to get out of the car and close the doors. Then the alarm arms itself and is ready to let out a howl that will panic anyone within a hundred yards. You have seven seconds or so after opening the car door to turn on that ignition key before all hell breaks loose. Imagine the panic some night when I get into the car and manage to drop the key. I am able to do this . . . I've proven it.

A few weeks ago I was getting out of the car and somehow the ignition key caught on the steering wheel and flipped out of my hand. Big deal, right? Well, Lin and I hunted for fifteen minutes trying to find where it went. We looked everywhere! We checked in the seats, under them, under the floor mats, glove compartments, and on and on and on. We checked outside the car . . . nothing! Was it an apport? Thank heavens I didn't have that alarm set up then.

Now, I'm ready for downtown Boston . . . even for New York! Perhaps I am being too smug. Knowing New York, they may well steal the alarm along with everything else. But they'll have to work for it and their eardrums will never be the same.

. . .W2NSD/1

SIMPLE SQUELCH

As anyone who has monitored a receiver for any length of time knows, a squelch is worth its weight in gold. Especially mobile, nothing can seem more tiring than constant reccíver noise.

A simple squelch arrangement can be added to most small transceivers, with minimum effort, to alleviate the problem. Two diodes and a few resistors are all that is needed to make this effective squelch.

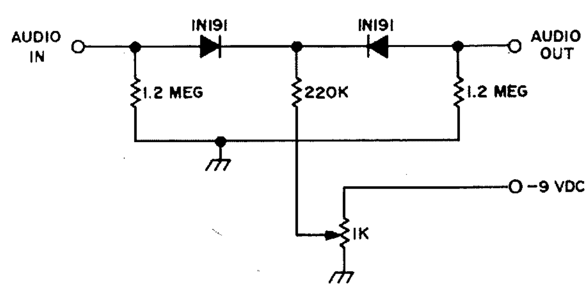


Fig. 1. Simple squelch circuit. Install before final audio amplifier.

The squelch circuit can be inserted between the last audio stage of the receiver and the final audio amplifier. The squelch level is set by varying the 1K pot. Power is most easily obtained from a 9V transistor battery.

. . .Larry Jack WA3AQS

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EAST COAST	14	7A	7	7	7	7	7	14	21	21A	21A	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.